BALDOR

# MicroFlex e100

Servo Drive

Installation manual

MN1942 01/06

# Contents

# Appendices

MicroFlex e100 is UL listed; file NMMS.E128059.

Limited Warranty
For a period of two (2) years from the date of original purchase, Baldor will repair or replace without charge controls and accessories that our examination proves to be defective in material or workmanship. This warranty is valid if the unit has not been tampered with by unauthorized persons, misused, abused, or improperly installed and has been used in accordance with the instructions and/or ratings supplied. This warranty is in lieu of any other warranty or guarantee expressed or implied. Baldor shall not be held responsible for any expense (including installation and removal), inconvenience, or consequential damage, including injury to any person or property caused by items of our manufacture or sale. (Some countries and U.S. states do not allow exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply.) In any event, Baldor's total liability, under all circumstances, shall not exceed the full purchase price of the control. Claims for purchase price refunds, repairs, or replacements must be referred to Baldor with all pertinent data as to the defect, the date purchased, the task performed by the control, and the problem encountered. No liability is assumed for expendable items such as fuses. Goods may be returned only with written notification including a Baldor Return Authorization Number and any return shipments must be prepaid.

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*See rear cover for other international offices*.

# Product notice

Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.
This equipment may be connected to other machines that have rotating parts or parts that are controlled by this equipment. Improper use can cause serious or fatal injury.

# Safety Notice

Intended use: These drives are intended for use in stationary ground based applications in industrial power installations according to the standards EN60204 and VDE0160. They are designed for machine applications that require variable speed controlled three-phase brushless AC motors. These drives are not intended for use in applications such as:

- Home appliances
- Medical instrumentation
- Mobile vehicles
- Ships
- Airplanes.

Unless otherwise specified, this drive is intended for installation in a suitable enclosure. The enclosure must protect the drive from exposure to excessive or corrosive moisture, dust and dirt or abnormal ambient temperatures. The exact operating specifications are found in section 8 of this manual. The installation, connection and control of drives is a skilled operation, disassembly or repair must not be attempted. In the event that a drive fails to operate correctly, contact the place of purchase for return instructions.

# Precautions


**DANGER**: Do not touch any circuit board, power device or electrical connection before you first ensure that no high voltage is present at this equipment or other equipment to which it is connected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt to start-up, program or troubleshoot this equipment.


**DANGER**: The motor circuit might have high voltages present whenever AC power is applied, even when the motor is not moving. Electrical shock can cause serious or fatal injury.


**DANGER**: If a motor is driven mechanically, it might generate hazardous voltages that are conducted to its power terminals. The enclosure must be earthed/grounded to prevent possible shock hazard.


**DANGER**: Be sure the system is properly earthed/grounded before applying power. Do not apply AC power before you ensure that earths/grounds are connected. Electrical shock can cause serious or fatal injury.

**WARNING**: Be sure all wiring complies with the National Electrical Code and all regional and local codes. Improper wiring may result in unsafe conditions.

**WARNING**: Be sure that you are completely familiar with the safe operation and programming of this equipment. This equipment may be connected to other machines that have rotating parts or parts that are controlled by this equipment. Improper use can cause serious or fatal injury.

**WARNING**: The stop input to this equipment should not be used as the single means of achieving a safety critical stop. Drive disable, motor disconnect, motor brake and other means should be used as appropriate.

**WARNING**: Improper operation or programming of the drive may cause violent motion of the motor and driven equipment. Be certain that unexpected motor movement will not cause injury to personnel or damage to equipment. Peak torque of several times the rated motor torque can occur during control failure.

**WARNING**: When operating a rotary motor with no load coupled to its shaft, remove the shaft key to prevent it flying out when the shaft rotates.

**WARNING**: A regeneration resistor may generate enough heat to ignite combustible materials. To avoid fire hazard, keep all combustible materials and flammable vapors away from the brake resistors.

**CAUTION**: To prevent equipment damage, be certain that the input power has correctly sized protective devices installed.

**CAUTION**: To prevent equipment damage, be certain that input and output signals are powered and referenced correctly.

**CAUTION**: To ensure reliable performance of this equipment be certain that all signals to/from the drive are shielded correctly.

**CAUTION**: Suitable for use on a circuit capable of delivering not more than the RMS symmetrical short circuit amperes listed here at rated voltage.

| Horsepower | RMS Symmetrical Amperes |
|---|---|
| 1-50 | 5,000 |

**CAUTION**: Avoid locating the drive immediately above or beside heat generating equipment, or directly below water or steam pipes.

**CAUTION**: Avoid locating the drive in the vicinity of corrosive substances or vapors, metal particles and dust.

**CAUTION**: Do not connect AC power to the drive terminals U, V and W. Connecting AC power to these terminals may result in damage to the drive.

**CAUTION**: Baldor does not recommend using “Grounded Leg Delta” transformer power leads that may create earth/ground loops and degrade system performance. Instead, we recommend using a four wire Wye.

**CAUTION**: Drives are intended to be connected to a permanent main power source, not a portable power source. Suitable fusing and circuit protection devices are required.

**CAUTION**: The safe integration of the drive into a machine system is the responsibility of the machine designer. Be sure to comply with the local safety requirements at the place where the machine is to be used. In Europe these are the Machinery Directive, the ElectroMagnetic Compatibility Directive and the Low Voltage Directive. In the United States this is the National Electrical code and local codes.

**CAUTION**: Drives must be installed inside an electrical cabinet that provides environmental control and protection. Installation information for the drive is provided in this manual. Motors and controlling devices that connect to the drive should have specifications compatible to the drive.

**CAUTION**: Failure to meet cooling air flow requirements will result in reduced product lifetime and/or drive overtemperature trips.

**CAUTION**: Violent jamming (stopping) of the motor during operation may damage the motor and drive.

**CAUTION**: Operating the MicroFlex e100 in Torque mode with no load attached to the motor can cause the motor to accelerate rapidly to excessive speed.

**CAUTION**: If the drive enable signal is already present when power is applied to the MicroFlex e100, the motor could begin to move immediately.

**CAUTION**: Do not tin (solder) exposed wires. Solder contracts over time and may cause loose connections. Use crimp connections where possible.

**CAUTION**: Electrical components can be damaged by static electricity. Use ESD (electrostatic discharge) procedures when handling this drive.

**CAUTION**: Ensure that encoder wires are properly connected. Incorrect installation may result in improper movement.

**CAUTION**: The threaded holes in the top and bottom of the case are for cable clamps. The holes are 11.5 mm deep and accept M4 screws, which must be screwed in to a depth of at least 8mm.

**CAUTION**: Removing the cover will invalidate UL certification.

**CAUTION**: The metal heatsink on the left side of the MicroFlex e100 can become very hot during normal operation.

## 2.1 MicroFlex e100 features

The MicroFlex e100 is a versatile brushless servo drive, providing a flexible and powerful motion control solution for rotary and linear motors. Standard features include:


- Single axis AC brushless drive.
- Range of models with continuous current ratings of 3A, 6A or 9A.
- Direct connection to 115VAC or 230VAC single-phase or 230VAC three-phase supplies.
- Universal feedback interface supporting incremental encoder, SSI, EnDat or SinCos feedback.
- Position, velocity and current control.
- Auto-tuning wizard (including position loop) and software oscilloscope facilities provided by Mint WorkBench v5.5 configuration software (supplied).
- 3 optically isolated general purpose digital inputs. Two inputs have 'fast input' capability, providing real-time position capture.
- 1 optically isolated drive enable input.
- 1 optically isolated general purpose digital output.
- 1 optically isolated digital output to indicate error conditions.
- USB 1.1 serial port (compatible with USB2.0).
- CANopen protocol for communication with Mint controllers and other third party CANopen devices.
- ETHERNET Powerlink & TCP/IP support: Twin Ethernet ports with integrated hub for communication with host PC or other ETHERNET Powerlink devices.

MicroFlex e100 will operate with a large range of brushless rotary and linear servo motors - for information on selecting Baldor servo motors, please see the sales brochure BR1202 available from your local Baldor representative.

This manual is intended to guide you through the installation of MicroFlex e100. The sections should be read in sequence.

The *Basic Installation* section describes the mechanical installation of the MicroFlex e100, the power supply connections and motor connections. The other sections require knowledge of the low level input/output requirements of the installation and an understanding of computer software installation. If you are not qualified in these areas you should seek assistance before proceeding.

## 2.2 Receiving and inspection

When you receive your MicroFlex e100, there are several things you should do immediately:

1. Check the condition of the shipping container and report any damage immediately to the carrier that delivered your MicroFlex e100.
2. Remove the MicroFlex e100 from the shipping container and remove all packing material. The container and packing materials may be retained for future shipment.
3. Verify that the catalog number of the MicroFlex e100 you received is the same as the catalog number listed on your purchase order. The catalog number is described in the next section.
4. Inspect the MicroFlex e100 for external damage during shipment and report any damage to the carrier that delivered your MicroFlex e100.
5. If MicroFlex e100 is to be stored for several weeks before use, be sure that it is stored in a location that conforms to the storage humidity and temperature specifications shown in section 8.1.13.

### 2.2.1 Identifying the catalog number

The MicroFlex e100 is available with different current ratings. The catalog number is marked on the side of the unit. It is a good idea to look for the catalog number (sometimes shown as ID/No:) and write it in the space provided here:

**Catalog number:** **MFE**_____

**Installed at:** _____ **Date:** _____

A description of a catalog number is shown here, using the example **MFE230A003**:

| | **Meaning** | **Alternatives** |
|---|---|---|
| **MFE** | MicroFlex e100 family | - |
| **230** | Requires an AC supply voltage of 115-230 Volts, 1Φ or 3Φ | - |
| **A003** | Continuous current rating of 3A | **A006**=6A; **A009**=9A |

## 2.3 Units and abbreviations

The following units and abbreviations are used in this manual:

V . . . . . Volt (also VAC and VDC)
W . . . . . Watt
A . . . . . Ampere
Ω . . . . . Ohm
µF . . . . . microfarad
pF . . . . . picofarad
mH . . . . . millihenry

Φ . . . . . phase
ms . . . . . millisecond
µs . . . . . microsecond
ns . . . . . nanosecond

mm . . . . . millimeter
m . . . . . meter
in . . . . . inch
ft . . . . . feet
lbf-in . . . . . pound force inch (torque)
N·m . . . . . Newton meter (torque)

ADC . . . . . Analog to Digital Converter
ASCII . . . . . American Standard Code for Information Interchange
AWG . . . . . American Wire Gauge
CAL . . . . . CAN Application Layer
CAN . . . . . Controller Area Network
CDROM . . . . . Compact Disc Read Only Memory
CiA . . . . . CAN in Automation International Users and Manufacturers Group e.V.
CTRL+E . . . . . on the PC keyboard, press **Ctrl** then **E** at the same time.
DAC . . . . . Digital to Analog Converter
DS301 . . . . . CiA CANopen Application Layer and Communication Profile
DS401 . . . . . CiA Device Profile for Generic I/O Devices
DS402 . . . . . CiA Device Profile for Drives and Motion Control
DS403 . . . . . CiA Device Profile for HMIs
EDS . . . . . Electronic Data Sheet
EMC . . . . . Electromagnetic Compatibility
EPL . . . . . ETHERNET Powerlink
HMI . . . . . Human Machine Interface
ISO . . . . . International Standards Organization
Kbaud . . . . . kilobaud (the same as Kbit/s in most applications)
LCD . . . . . Liquid Crystal Display
Mbps . . . . . megabits/s
MB . . . . . megabytes
MMC . . . . . Mint Machine Center
*(NC)* . . . . . Not Connected
RF . . . . . Radio Frequency
SSI . . . . . Synchronous Serial Interface
TCP/IP . . . . . Transmission Control Protocol / Internet Protocol
UDP . . . . . User Datagram Protocol

# 3.1 Introduction

**You should read all the sections in *Basic Installation* to ensure safe installation.**
This section describes the mechanical and electrical installation of the MicroFlex e100 in the following stages:

- Location considerations
- Mounting the MicroFlex e100
- Connecting the AC power supply
- Connecting the 24VDC control circuit supply
- Connecting the motor
- Installing a regeneration resistor (Dynamic Brake)
- Connecting the feedback device

**These stages should be read and followed in sequence.**

## 3.1.1 Power sources

A 115 - 230VAC power source (IEC1010 over-voltage category III or less) in the installation area is required. This may be single-phase or three-phase. An AC power filter is required to comply with the CE directive for which the MicroFlex e100 was tested (see section 3.4.7).

The 24VDC control circuit supply must be a regulated power supply with a continuous current supply capability of 1A (4A power on surge).

## 3.1.2 Hardware requirements

The components you will need to complete the basic installation are:

- 24VDC power supply.
- AC power supply filter (for CE compliance).
- The motor that will be connected to the MicroFlex e100.
- A motor power cable.
- An encoder feedback cable, SSI cable, or EnDat / SinCos cable. A separate Hall cable might also be required for linear motors.
- A USB cable.
- (Optional) A regeneration resistor (Dynamic Brake) might be required, depending on the application. Without the regeneration resistor, the drive may produce an overvoltage fault. All MicroFlex e100 models have overvoltage sensing circuitry. Regeneration resistors may be purchased separately - see Appendix A.
- A cooling fan may be required to allow operation of the MicroFlex e100 at full rated current (see section 3.2.2).

- A PC with the following specification:

| | Minimum specification | Recommended specification |
|---|---|---|
| **Processor** | Intel Pentium 500MHz | Intel PentiumIII 1GHz or faster |
| **RAM** | 64MB | 128MB |
| **Hard disk space** | 40MB | 40MB |
| **CD-ROM** | A CD-ROM drive | |
| **Communication** | USB port or Ethernet* port | |
| **Screen** | 1024 x 768, 16-bit color | 1152 x 864, 16-bit color |
| **Mouse** | A mouse or similar pointing device | |
| **Operating system** | Windows 2000 or Windows XP | |

* The Ethernet configuration used by a normal office PC is not suitable for direct communication with the MicroFlex e100. It is recommended to install a separate dedicated Ethernet adapter in the PC, which can be configured for use with the MicroFlex e100. See section 6.2.4.

### 3.1.3 Tools and miscellaneous hardware

- Your PC operating system user manual might be useful if you are not familiar with Windows.
- Small screwdriver(s) with a blade width of 3mm or less for connector X1, and 2.5mm (1/10 in) or less for connector X3.
- M5 screws or bolts for mounting the MicroFlex e100.

### 3.1.4 Other information needed for installation

This information is useful (but not essential) to complete the installation:

- The data sheet or manual provided with your motor, describing the wiring information of the motor cables/connectors.
- Knowledge of whether the digital input signals will be ‘Active Low’ or ‘Active High’.

## 3.2 Mechanical installation and cooling requirements

**It is essential that you read and understand this section before beginning the installation**.


**CAUTION**: To prevent equipment damage, be certain that the input power has correctly rated protective devices installed.


**CAUTION**: To prevent equipment damage, be certain that input and output signals are powered and referenced correctly.


**CAUTION**: To ensure reliable performance of this equipment be certain that all signals to/from the MicroFlex e100 are shielded correctly.


**CAUTION**: Avoid locating the MicroFlex e100 immediately above or beside heat generating equipment, or directly below water steam pipes.

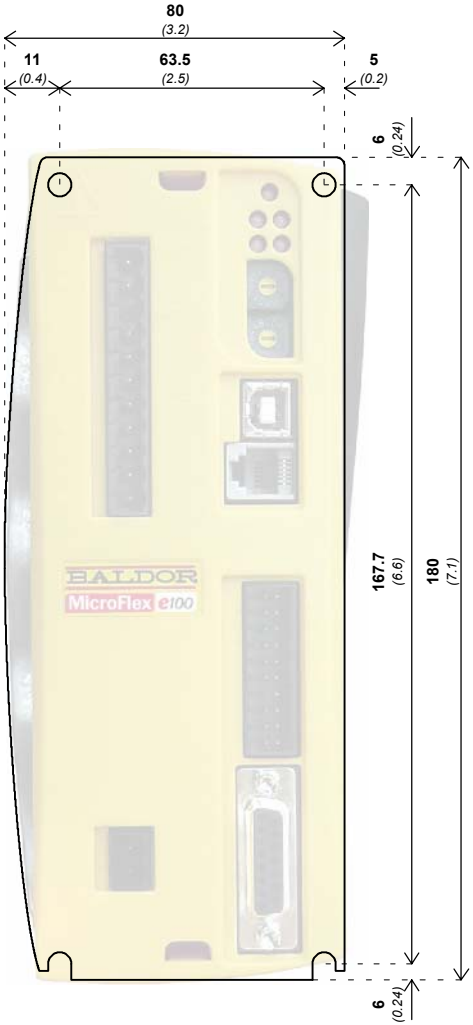

**CAUTION**: Avoid locating the MicroFlex e100 in the vicinity of corrosive substances or vapors, metal particles and dust.


**CAUTION**: Failure to meet cooling air flow requirements will result in reduced product lifetime and/or drive overtemperature trips.

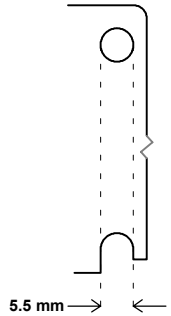
The safe operation of this equipment depends upon its use in the appropriate environment. The following points must be considered:

- The MicroFlex e100 must be installed indoors, permanently fixed and located so that it can only be accessed by service personnel using tools.
- The maximum suggested operating altitude is 1000m (3300ft).
- The MicroFlex e100 must be installed where the pollution degree according to IEC664 shall not exceed 2.
- The 24VDC control circuit supply must be installed so that the 24VDC supplied to the unit is isolated from the AC supply using double or reinforced insulation.
- The input of the control circuit must be limited to Safety Extra Low Voltage circuits.
- Both the AC supply and the 24VDC supply must be fused.
- The atmosphere must not contain flammable gases or vapors.
- There must not be abnormal levels of nuclear radiation or X-rays.
- To comply with CE directive 89/336/EEC an appropriate AC filter must be installed.
- The MicroFlex e100 must be secured by the slots in the flange. The protective earth/ground (the threaded hole on the top of the MicroFlex e100) must be bonded to a safety earth/ground using either a 25A conductor or a conductor of three times the peak current rating - whichever is the greater.
- The threaded holes in the top and bottom of the case are for cable clamps. The holes are threaded for M4 bolts no longer than 11mm (0.43 in) in length.
- The D-type connectors on the front panel of the MicroFlex e100 are secured using two hexagonal jack screws (sometimes known as “screwlocks”). If a jack screw is removed accidentally or lost it must be replaced with a #4-40 UNC jack screw with an external male threaded section no longer than 10mm (0.4 in).

### 3.2.1 Dimensions




Mounting hole and slot detail




Dimensions shown as: **mm** *(inches)*.

Depth: **157 mm** *(6.2 in)*
Weight: 3A: 1.45kg *(3.2lb)*
6A: 1.50kg *(3.3lb)*
9A: 1.55kg *(3.4lb)*

**Figure 1 - Mounting and overall dimensions**

## 3.2.2 Mounting and cooling the MicroFlex e100

Ensure you have read and understood the *Mechanical installation and location requirements* in section 3.2. Mount the MicroFlex e100 vertically on its rear side, the side opposite the front panel. M5 bolts or screws should be used to mount the MicroFlex e100. Detailed dimensions are shown in section 3.2.1.

For effective cooling, the MicroFlex e100 must be mounted upright on a smooth vertical metal surface. The MicroFlex e100 is designed to operate in an ambient temperature of 0°C to 45°C (32°F to 113°F). Output current must be derated between 45°C (113°F) and the absolute maximum ambient temperature of 55°C (131°F). Within the ambient temperature range:

The 3A model is designed to operate without any additional cooling methods.
The 6A and 9A models require a forced air flow, passing vertically from the bottom to the top of the MicroFlex e100 case, to allow full rated current at 45°C (113°F).

Temperature derating characteristics are shown in sections 3.2.3 to 3.2.5.

**Note:** Failure to meet cooling air flow requirements will result in reduced product lifetime and/or drive overtemperature trips. It is recommended to check periodically the operation of the cooling equipment. Optional fan tray FAN001-024, mounted exactly as shown in section A.1.1., ensures that correct cooling is provided and allows the MicroFlex e100 to be UL listed.

### 3.2.2.1 Effects of mounting surface and proximity

The proximity of the MicroFlex e100 to other components could affect cooling efficiency. If the MicroFlex e100 is mounted beside another MicroFlex e100 (or other obstruction), there should be a minimum space of 15mm to maintain effective cooling.

If the MicroFlex e100 is mounted above or below another MicroFlex e100 (or other obstruction), there should be a minimum space of 90mm to maintain effective cooling. Remember that when a MicroFlex e100 is mounted above another MicroFlex e100 or heat source, it will be receiving air that has been already heated by the device(s) below it. Multiple MicroFlex e100 units mounted above each other should be aligned, not offset, to promote air flow across the heatsinks.

The derating characteristics assume the MicroFlex e100 is mounted on 3mm thick (or less) metal plate. If the MicroFlex e100 is mounted on 10mm plate then the current characteristics shown in sections 3.2.3 to 3.2.5 may be increased by up to 7% if there is no forced air cooling, or 15% if forced air cooling is present.

It is recommended to allow approximately 60mm at the front to accommodate wiring and connectors.

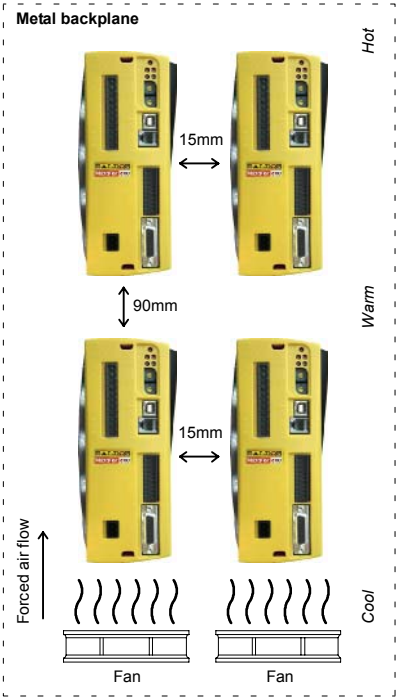
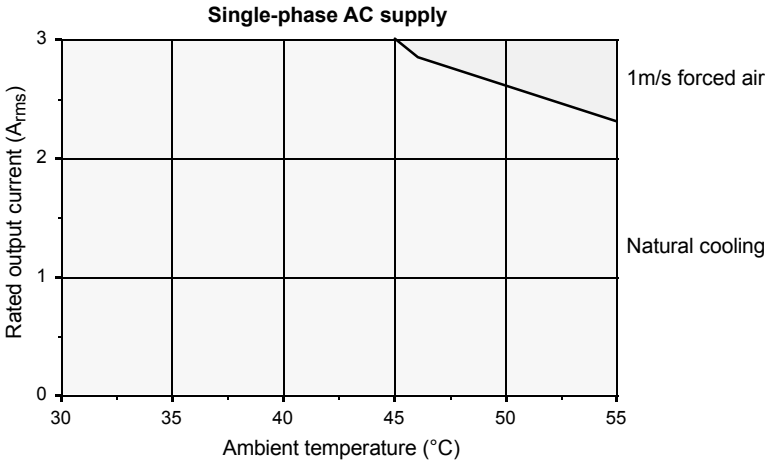
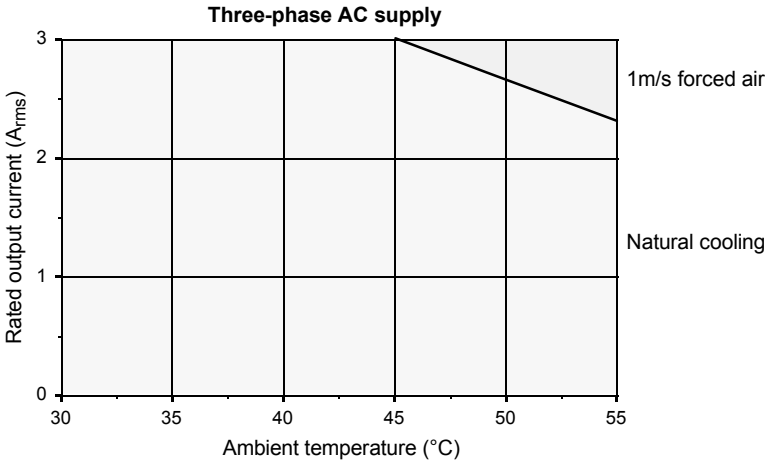



**Figure 2 - Cooling and proximity**

### 3.2.3 Derating characteristic - 3A model

The following derating characteristics are for model MFE230A00**3**.

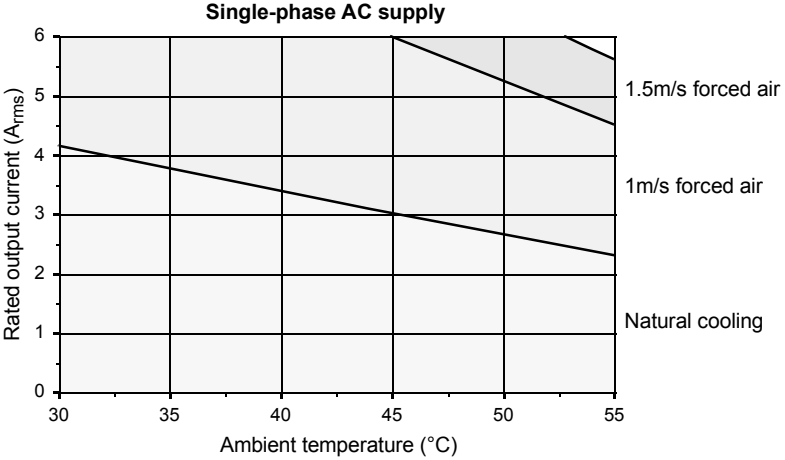


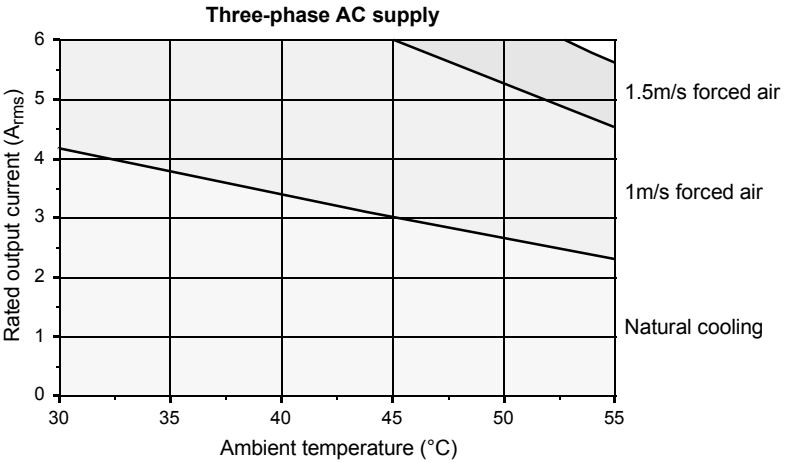




**Notes:**
Load power factor = 0.75.
Overload limit for model MFE230A003 is 6A.

### 3.2.4 Derating characteristic - 6A model

The following derating characteristics are for model MFE230A00**6**.

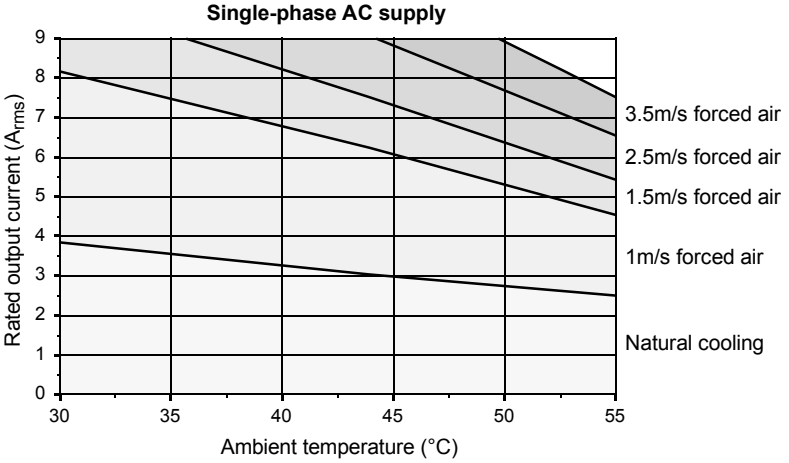


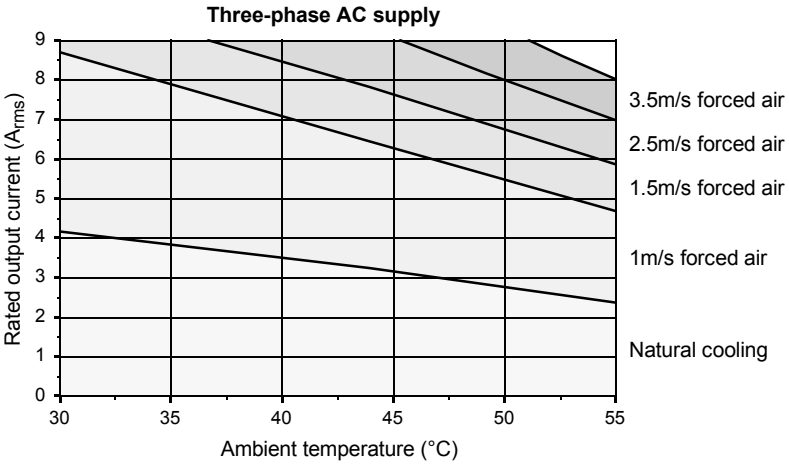




**Notes:**
Load power factor = 0.75.
Overload limit for model MFE230A006 is 12A.

### 3.2.5 Derating characteristic - 9A model

The following derating characteristics are for model MFE230A00**9**.




**Notes:**
Load power factor = 0.78.
Overload limit for model MFE230A009 is 18A.

### 3.2.6 Overtemperature trips

The MicroFlex e100 contains internal temperature sensors that will cause it to trip and disable if the temperature exceeds 80°C on the 3A model, or 75°C on the 6A and 9A models. This limit can be read using the `TEMPERATURELIMITFATAL` keyword - see the Mint help file for details.

# 3.3 Connector locations

## 3.3.1 Front panel connectors


### X1 Power

| | |
|---|---|
| ⏚ | Earth/Ground |
| ⏚ | Earth/Ground |
| | *(NC)* |
| L1 | AC Phase 1 / L |
| L2 | AC Phase 2 / N |
| L3 | AC Phase 3 |
| U | Motor U |
| V | Motor V |
| W | Motor W |
| R1 | Regen |
| R2 | Regen |

### LEDs

The STATUS, CAN and ETHERNET LEDs are described in section 7.2.1.

### Node ID

These switches set the MicroFlex e100's node ID for ETHERNET Powerlink, and the final value of the IP address when using TCP/IP. See sections 5.6.1 and 6.2.4.

### USB

| | |
|---|---|
| 1 | *(NC)* |
| 2 | Data- |
| 3 | Data+ |
| 4 | GND |

### X6 Auxiliary port

(Currently unused)

### X3 Input / Output

| | | | |
|---|---|---|---|
| 1 | Status- | 11 | Status+ |
| 2 | DGND | 12 | DGND |
| 3 | DOUT1- | 13 | DOUT1+ |
| 4 | DIN2- | 14 | DIN2+ |
| 5 | DGND | 15 | DGND |
| 6 | DIN1- | 16 | DIN1+ |
| 7 | DIN0- | 17 | DIN0+ |
| 8 | DGND | 18 | DGND |
| 9 | Drive enable- | 19 | Drive enable+ |
| 10 | Shield | 20 | Shield |

### X8 Feedback In

| Pin | Incremental | SinCos | SSI | EnDat |
|---|---|---|---|---|
| 1 | CHA+ | *(NC)* | Data+ | Data+ |
| 2 | CHB+ | *(NC)* | Clock+ | Clock+ |
| 3 | CHZ+ | *(NC)* | *(NC)* | *(NC)* |
| 4 | Sense | Sense | Sense | Sense |
| 5 | Hall U- | Sin- | *(NC)* | Sin-* |
| 6 | Hall U+ | Sin+ | *(NC)* | Sin+* |
| 7 | Hall V- | Cos- | *(NC)* | Cos-* |
| 8 | Hall V+ | Cos+ | *(NC)* | Cos+* |
| 9 | CHA- | *(NC)* | Data- | Data- |
| 10 | CHB- | *(NC)* | Clock- | Clock- |
| 11 | CHZ- | *(NC)* | *(NC)* | *(NC)* |
| 12 | +5V out | +5V out | +5V out | +5V out |
| 13 | DGND | DGND | DGND | DGND |
| 14 | Hall W- | *(NC)* | *(NC)* | *(NC)* |
| 15 | Hall W+ | *(NC)* | *(NC)* | *(NC)* |
| Shell | Shield | Shield | Shield | Shield |

* EnDat v2.1 only. EnDat v2.2 does not use the Sin and Cos signals.

### X2 Control circuit power

0V
+24V

*(NC)* = Not Connected. Do not make a connection to this pin.

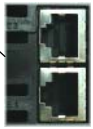
Tightening torque for terminal block connections (X1 & X3) is 0.5-0.6Nm (4.4-5.3 lb-in). Maximum wire sizes: X1: 2.5mm$^2$; X3: 0.5mm$^2$.

## 3.3.2 Top panel connectors

**CAN**

| | |
|---|---|
| 1 | (NC) |
| 2 | CAN- |
| 3 | CAN GND |
| 4 | *(NC)* |
| 5 | Shield |
| 6 | CAN GND |
| 7 | CAN+ |
| 8 | *(NC)* |
| 9 | CAN V+ |

**Ethernet**



| | |
|---|---|
| 1 | TX+ |
| 2 | TX- |
| 3 | RX+ |
| 4 | *(NC)* |
| 5 | *(NC)* |
| 6 | RX- |
| 7 | *(NC)* |
| 8 | *(NC)* |

Both connectors have identical pinouts.

# 3.4 Power connections

This section provides instructions for connecting the AC power supply.

The installer of this equipment is responsible for complying with NEC (National Electric Code) guidelines or CE (Conformite Europeene) directives and application codes that govern wiring protection, earthing/grounding, disconnects and other current protection.

**DANGER**: **Electrical shock can cause serious or fatal injury. Do not touch any power device or electrical connection before you first ensure that power has been disconnected and there is no high voltage present from this equipment or other equipment to which it is connected.**

MicroFlex e100 drives are designed to be powered from standard single and three-phase lines that are electrically symmetrical with respect to earth/ground. The power supply module within all MicroFlex e100 models provides rectification, smoothing and current surge protection. Fuses or circuit breakers are required in the input lines for cable protection.

**Note:** A Residual Current Device (RCD) must not be used for fusing the drive. An appropriate type of circuit breaker or fuse must be used.

All interconnection wires should be in metal conduits between the MicroFlex e100, AC power source, motor, host controller and any operator interface stations. Use UL listed closed loop connectors that are of appropriate size for the wire gauge being used. Connectors are to be installed using only the crimp tool specified by the manufacturer of the connector. Only class 1 wiring should be used.

## 3.4.1 Earthing / grounding

A permanent earth/ground bonding point is provided on the heatsink, which must be used as the protective earth. It is labeled with the protective earth symbol in the casting and does not form any other mechanical function.

Connector X1 contains earth terminals, but these must not be used as protective earth since the connector does not guarantee earth connection first, disconnection last. Earthing methods are shown in section 3.4.2.

**Note:** When using unearthed/ungrounded distribution systems, an isolation transformer with an earthed/grounded secondary is recommended. This provides three-phase AC power that is symmetrical with respect to earth/ground and can prevent equipment damage.

### 3.4.1.1 Protection class

User protection has been achieved using Protective Class I (EN61800-5-1, 3.2.20), which requires an earth connection to the unit whenever hazardous voltages are applied. The equipment provides protection against electric shock by:

- Means of connection of protective earth to accessible live conductive parts.
- Basic insulation.

### 3.4.1.2 Earth leakage

Maximum earth leakage from the MicroFlex e100 is 3.4mA per phase (230V 50Hz supply). This value does not include the earth leakage from the AC power filter, which could be much larger (see section A.1.3). If the MicroFlex e100 and filter are mounted in an enclosure, it is recommended the enclosure is earthed using a 10mm$^2$ conductor.

## 3.4.2 Single-phase or three-phase power connections

| Location | Connector X1 (Mating connector: Phoenix COMBICON MSTB 2,5HC/11-ST-5,08) |
|---|---|
| **Nominal input voltage** | 115VAC or 230VAC, 1Φ or 3Φ line to line |
| **Minimum input voltage** | 105VAC, 1Φ or 3Φ line to line (see Note*) |
| **Maximum input voltage** | 250VAC, 1Φ or 3Φ line to line |

**Note:** * The MicroFlex e100 will operate at lower input voltages, although performance could be impaired. The drive will trip if the DC-bus voltage falls below 50V or 60% of the no-load voltage, whichever occurs first.

For three phase supplies, connect supply to L1, L2 and L3 as shown in Figure 3. For single phase supplies, connect the supply and neutral to any two line inputs, for example L1 and L2.

For CE compliance, an AC filter must be connected between the AC power supply and the MicroFlex e100. If local codes do not specify different regulations, use at least the same gauge wire for earth/ground as is used for L1, L2 and L3.

Tightening torque for terminal block connections is 0.5-0.6Nm (4.4-5.3 lb-in). The threaded hole in the top and bottom of the case may be used as an additional functional earth/ground connection for signals on connector X3. They may also be used to attach shield or strain relief clamps. The holes are threaded for M4 bolts no longer than 11mm (0.43 in) in length.

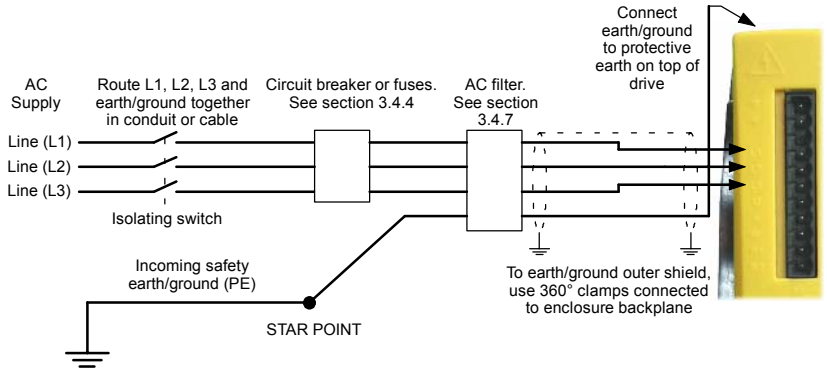



**Figure 3 - Single or three-phase power connections**

## 3.4.3 Input power conditioning

Certain power line conditions must be avoided; an AC line reactor, an isolation transformer or a step up/step down transformer may be required for some power conditions:

- If the feeder or branch circuit that provides power to the MicroFlex e100 has permanently connected power factor correction capacitors, an input AC line reactor or an isolation transformer must be connected between the power factor correction capacitors and the MicroFlex e100 to limit the maximum symmetrical short circuit current to 5000A.
- If the feeder or branch circuit that provides power to the MicroFlex e100 has power factor correction capacitors that are switched on line and off line, the capacitors must not be switched while the drive is connected to the AC power line. If the capacitors are switched on line while the drive is still connected to the AC power line, additional protection is required. A Transient Voltage Surge Suppressor (TVSS) of the proper rating must be installed between the AC line reactor (or isolation transformer) and the AC input to the MicroFlex e100.

#### 3.4.3.1 Input power-cycling and inrush

If AC power has been removed from the MicroFlex e100, it should remain disconnected for the period specified in Table 1, before it is reapplied.

| **MicroFlex e100 current rating** | **Minimum power cycle delay period** (seconds) |
|---:|:---:|
| **3A** | 25 |
| **6A** | 45 |
| **9A** | 65 |

**Table 1 - Power cycle intervals**

This delay allows the input surge protection circuit to perform correctly, ensuring that the inrush current (typically 1.7A) is below the drive rated current. Power-cycling the drive more frequently could cause high inrush current and corresponding nuisance operation of circuit breakers or fuses. Repeated failure to observe the delay period could reduce the lifetime of the MicroFlex e100.

#### 3.4.3.2 Discharge period

**DANGER**: After AC power has been removed from the MicroFlex e100, high voltages (greater than 50VDC) can remain on the regeneration resistor connections until the DC-bus circuitry has discharged. The high voltage can remain for the period specified in Table 2.

| **MicroFlex e100 current rating** | **Time for DC-bus to discharge to 50V or less** (maximum, seconds) |
|---:|:---:|
| **3A** | 83 |
| **6A** | 166 |
| **9A** | 248 |

**Table 2 - DC-bus discharge periods**

#### 3.4.3.3 Supplying input power from a variac (variable transformer)

When AC power is supplied from a variac, the MicroFlex e100's pre-charge circuit may not operate correctly. To ensure that the pre-charge circuitry operates correctly, increase the variac voltage to the desired level and then power cycle the 24VDC control circuit supply. This will restart the pre-charge circuit and allow it to operate correctly.

## 3.4.4 Power disconnect and protection devices

A power disconnect should be installed between the input power supply and the MicroFlex e100 for a fail-safe method to disconnect power. The MicroFlex e100 will remain in a powered condition until all input power is removed from the drive and the internal bus voltage has depleted.

The MicroFlex e100 must have a suitable input power protection device installed, preferably a fuse. Recommended circuit breakers are thermal magnetic devices (1 or 3 phase as required) with characteristics suitable for heavy inductive loads (C-type trip characteristic). Circuit breaker or fuses are not supplied - see section 3.4.5. For CE compliance, see Appendix C.

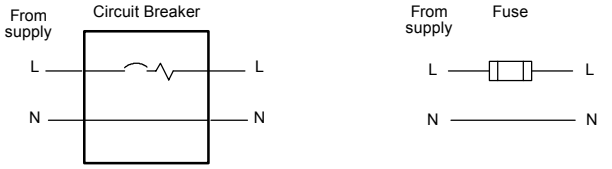



**Figure 4 - Circuit breaker and fuse, single-phase**

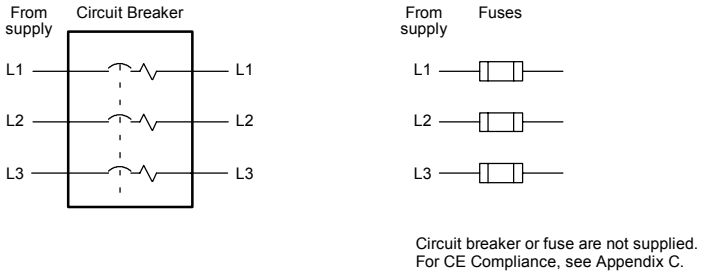



**Figure 5 - Circuit breaker and fuse, three-phase**

**Note:** Metal conduit or shielded cable should be used. Connect conduits so the use of a line reactor or RC device does not interrupt EMI/RFI shielding.

#### 3.4.4.1 Using 2 phases of a 3-phase supply

Power may be derived by connecting two phases of an appropriate three-phase supply (L1 and L2 for example). When supplying AC power in this way, the voltage between the two phases must not exceed the rated input voltage of the MicroFlex e100. A two pole breaker must be used to isolate both lines. Fuses must be fitted in both lines.

### 3.4.5 Recommended fuses, circuit breakers and wire sizes

Table 3 describes the recommended fuses, circuit breakers and suitable wires sizes to be used for power connections.

| Catalog Number | Cont. Output Amps (RMS) | AC Supply Type | Input Fuse | Circuit breaker (C-type) | Minimum Wire Gauge | |
|---|---|---|---|---|---|---|
| | | | | | AWG | $mm^2$ |
| **MFE..A003** | 3A | 1Φ | Ferraz Shawmut:<br>6x32 FA series, 10A (W084314P)<br>or<br>BS88 2.5 URGS 10A (N076648) | 10A | 14 | 2.0 |
| | | 3Φ | Ferraz Shawmut:<br>6x32 FA series, 8A (V084313P)<br>or<br>BS88 2.5 URGS, 7A (M076647) | 8A | 14 | 2.0 |
| **MFE..A006** | 6A | 1Φ | Ferraz Shawmut:<br>6x32 FA series, 20A (A084318P)<br>or<br>BS88 2.5 URGS, 20A (L097507) | 20A | 14 | 2.0 |
| | | 3Φ | Ferraz Shawmut:<br>6x32 FA series, 12.5A<br>(X084315P)<br>or<br>BS88 2.5 URGS, 12A (P076649) | 12.5A | 14 | 2.0 |
| **MFE..A009** | 9A | 1Φ | Ferraz Shawmut:<br>BS88 2.5 URGS, 25A (R076651) | 25A | 14 | 2.5 |
| | | 3Φ | Ferraz Shawmut:<br>6x32 FA series, 20A (A084318P)<br>or<br>BS88 2.5 URGS, 20A (L097507) | 20A | 14 | 2.0 |

**Table 3 - Protection device and wire ratings**

**Note:** All wire sizes are based on 75°C (167°F) copper wire. Higher temperature smaller gauge wire may be used per National Electric Code (NEC) and local codes. Recommended fuses are based on 25°C (77°F) ambient, maximum continuous control output current and no harmonic current. Earth/ground wires must be the same gauge, or larger, than the Line wires.

### 3.4.6 Drive overload protection

The MicroFlex e100 will immediately trip and disable if there is an overload condition. The parameters for managing drive overloads are configured automatically by the Commissioning Wizard (see section 6.4.3). If they need to be changed, use the Parameters tool in Mint WorkBench (see section 6.5.2).

## 3.4.7 Power supply filters

To comply with EEC directive 89/336/EEC, an AC power filter of the appropriate type must be connected. This can be supplied by Baldor and will ensure that the MicroFlex e100 complies with the CE specifications for which it has been tested. Ideally, one filter should be provided for each MicroFlex e100; filters should not be shared between drives or other equipment. Table 4 lists the appropriate filters:

| MicroFlex e100 current rating | Input voltages | |
|---|---|---|
| | **230VAC, 1Φ** | **230VAC, 3Φ** |
| **3A** | FI0015A00 + line reactor (see sections 3.4.7.1 and 3.4.7.2) *or* FI0029A00 (see section A.1.2) | FI0018A00 |
| **6A** | FI0015A02 (see section 3.4.7.2) *or* FI0029A00 (see section A.1.2) | FI0018A00 |
| **9A** | FI0029A00 (see section A.1.2) | FI0018A03 |

**Table 4 - Baldor filter part numbers**

Maximum earth leakage from the MicroFlex e100 is 3.4mA per phase (230V 50Hz supply). This value does not include the earth leakage from the AC power filter, which could be much larger (see section A.1.3).

### 3.4.7.1 Harmonic suppression

When operating the 3A MicroFlex e100 (part MFE230A003) on a single-phase AC supply, a 13mH $4A_{rms}$ (10A peak) line reactor is required to ensure compliance with EN61000-3-2:2000 class A limits, when the total equipment supply load is less than 1kW.

### 3.4.7.2 Reversing the filter

When using filters FI0015A00 or FI0015A02 as specified in Table 4, they must be reversed to ensure that the MicroFlex e100 complies with the CE specifications for which it has been tested. The AC power supply should be connected to the filter terminals marked as the outputs, with the MicroFlex e100 connected to the filter terminals marked as the inputs.

**WARNING**: This recommendation applies only to filters FI0015A00 and FI0015A02. Alternative filters or protection devices must be connected as specified by the manufacturer.

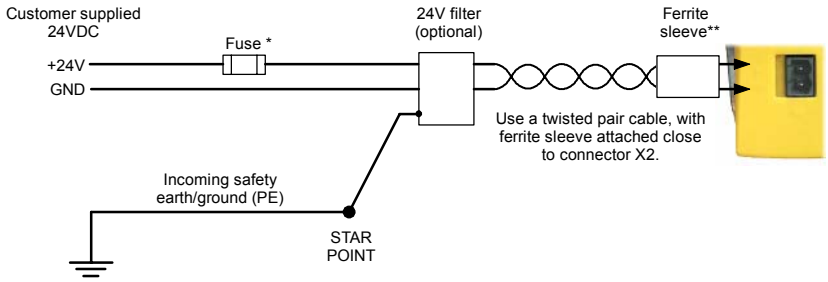
### 3.4.8 24V control circuit supply

A 24VDC supply must be provided to power the controlling electronics. This is useful for safety reasons where AC power needs to be removed from the power stage but the controlling electronics must remain powered to retain position and I/O information.

A separate fused 24V supply should be provided for the MicroFlex e100. If other devices are likely to be powered from the same 24V supply, a filter (Baldor catalog number FI0014A00) should be installed to isolate the MicroFlex e100 from the rest of the system. Alternatively, a ferrite sleeve may be attached to the supply cable near connector X2.

| | |
|---|---|
| **Location** | Connector X2 |
| **Nominal input voltage** | 24V |
| **Range** | 20-30VDC |
| **Input current**<br>Maximum<br>Typical | <br>1A continuous (4A typical power on surge, limited by NTC)<br>0.5A - 0.6A (not powering feedback device)<br>0.6A - 0.8A (powering feedback device) |

Tightening torque for terminal block connections is 0.5-0.6Nm (4.4-5.3 lb-in).




* Recommended fuse: Bussman S504 20x5mm anti-surge 2A.
** Recommended ferrite sleeve: Fair-Rite part 0431164281 or similar.

**Figure 6 - 24V control circuit supply connections**

## 3.5 Motor connections

MicroFlex e100 will operate with a large number of brushless servo motors. For information on selecting Baldor servo motors please see the sales brochure BR1202, available from your local Baldor representative. The motor must be capable of being powered by an inverter PWM output - see section 8.1.3 for details. The motor can be connected directly to the MicroFlex e100 or through a motor contactor (M-Contactor). The motor outputs are conditionally short-circuit proof. Motors should ideally have a minimum inductance of 1mH per winding; for motors with lower inductance an output reactor may be fitted in series with the motor.

When using a Baldor motor, the parameters for managing motor overloads are configured automatically by the Commissioning Wizard (see section 6.4.3). If they need to be changed, or you are using an alternative motor, use the Parameters tool in Mint WorkBench (see section 6.5.2).

| **Location** | Connector X1 | | |
|---|---|---|---|
| **AC supply voltage** | 115VAC, 1Φ | 230VAC, 1Φ | 230VAC, 3Φ |
| **Output voltage range** | 0-115VAC, 3Φ | 0-230VAC, 3Φ | 0-230VAC, 3Φ |

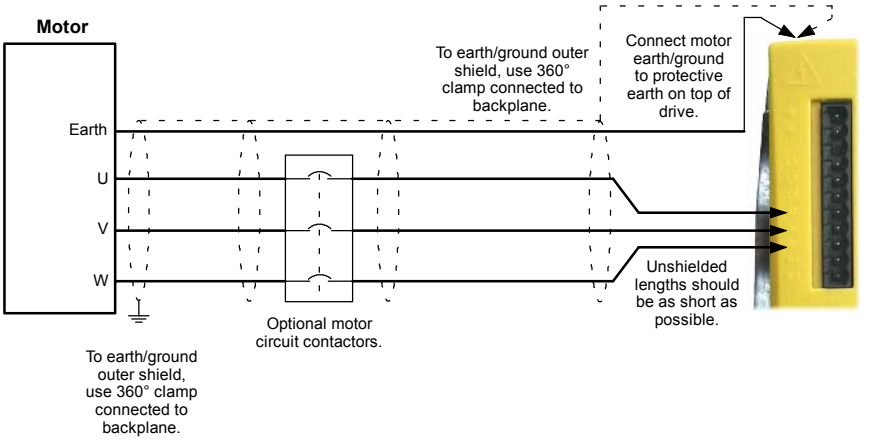



**Figure 7 - Motor connections**

**CAUTION**: Do not connect supply power to the MicroFlex e100 UVW outputs. The MicroFlex e100 might be damaged.

**CAUTION**: The motor leads U, V and W must be connected to their corresponding U, V or W terminal on the motor. Misconnection will result in uncontrolled motor movement.

The motor power cable must be shielded for CE compliance. The connector or gland used at the motor must provide 360 degree shielding. The maximum recommended cable length is 30.5m (100ft).

**Note:** For CE compliance the motor earth/ground should be connected to the drive earth/ground.

### 3.5.1 Motor circuit contactors

If required by local codes or for safety reasons, an M-Contactor (motor circuit contactor) may be installed to provide a physical disconnection of the motor windings from the MicroFlex e100 (see section 3.5). Opening the M-Contactor ensures that the MicroFlex e100 cannot drive the motor, which may be necessary during equipment maintenance or similar operations. Under certain circumstances, it may also be necessary to fit a brake to a rotary motor. This is important with hanging loads where disconnecting the motor windings could result in the load falling. Contact your local supplier for details of appropriate brakes.

**CAUTION**: If an M-Contactor is installed, the MicroFlex e100 must be disabled at least 20ms before the M-Contactor is opened. If the M-Contactor is opened while the MicroFlex e100 is supplying voltage and current to the motor, the MicroFlex e100 may be damaged. Incorrect installation or failure of the M-Contactor or its wiring may result in damage to the MicroFlex e100.

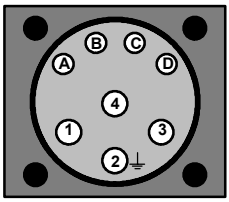
Ensure that shielding of the motor cable is continued on both sides of the contactor.

### 3.5.2 Motor power cable pin configuration - Baldor BSM rotary motors

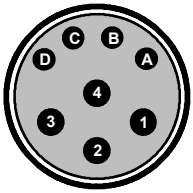
Figure 8 shows the pin configuration for a typical Baldor motor cable, part number CBL025SP-12:

| Signal name | Motor / cable pin | Motor cable wire color |
|---|---|---|
| **Motor U** | 1 | Black, labeled ‘1’ |
| **Motor V** | 4 | Black, labeled ‘2’ |
| **Motor W** | 3 | Black, labeled ‘3’ |
| **Earth/ground** | 2 | Green/Yellow |
| **Thermal switch** | A | Green |
| **Thermal switch** | B | White |
| **Brake** | C | Blue |
| **Brake** | D | Red |

Note:
Not all motors are fitted with a brake so pins C and D might not be connected.




Motor power connector (male)




Cable connector end view (female)

**Figure 8 - Baldor motor power cable pin configuration**

### 3.5.3 Motor cable pin configuration - Baldor linear motors

The following table shows the pin colors used in a typical Baldor linear motor cable set, part number AY1763A00:

| Signal name | Motor cable wire color |
|---|---|
| **Motor U** | Black |
| **Motor V** | Red |
| **Motor W** | White |
| **Motor ground** | Green |
| **Thermal switch** | Blue |
| **Thermal switch** | Orange |

| Signal name | Hall cable wire color |
|---|---|
| **Hall 1 (U)** | White |
| **Hall 2 (V)** | Red |
| **Hall 3 (W)** | Black |
| **Hall ground** | Green |
| **Hall +5VDC** | Brown |

### 3.5.4 Sinusoidal filter

A sinusoidal filter is used to provide a better quality waveform to the motor, reducing motor noise, temperature and mechanical stress. It will reduce or eliminate harmful dV/dt values (voltage rise over time) and voltage doubling effects which can damage motor insulation. This effect occurs most noticeably when using very long motor cables, for example 30m (100 ft) or more. Baldor motors intended to be used with drives are designed to withstand the effects of large dV/dt and overvoltage effects. However, if very long motor cables are unavoidable and are causing problems, then a sinusoidal filter may be beneficial.

### 3.5.5 Thermal switch connection

You might wish to wire the motor's thermal switch contacts (normally closed), using a relay, to a digital input on connector X3 (see section 3.3.1). Using the Mint WorkBench Digital I/O tool, the input can be configured to be the motor trip input. This allows the MicroFlex e100 to respond to motor over-temperature conditions. The Mint keyword `MOTORTEMPERATUREINPUT` can also be used to configure a digital input for this purpose. A typical circuit, using DIN1 as the input, is shown in Figure 9.

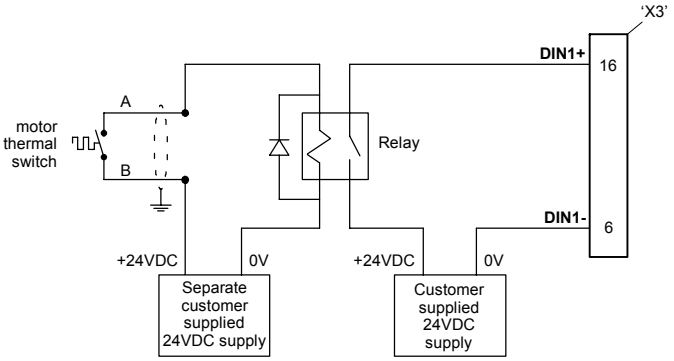



**Figure 9 - Motor thermal switch circuit**

**CAUTION**: The 24VDC power supply connected to the thermal switch must be a separate supply as shown in Figure 9. Do not use the 24V supply used for the drive enable signal, or the internally generated supply (if present). The thermal switch wires often carry noise that could cause erratic drive operation or damage. The thermal switch contacts must never be wired directly to a digital input.

The separate 24VDC supply used for the thermal switch may also be used for the motor brake circuit (section 3.5.6).

## 3.5.6 Motor brake connection

You might wish to wire a motor's brake, via relays, to digital outputs on connector X3 (see section 3.3.1). This provides a way for the MicroFlex e100 to control the motor's brake. A typical circuit is shown in Figure 10.

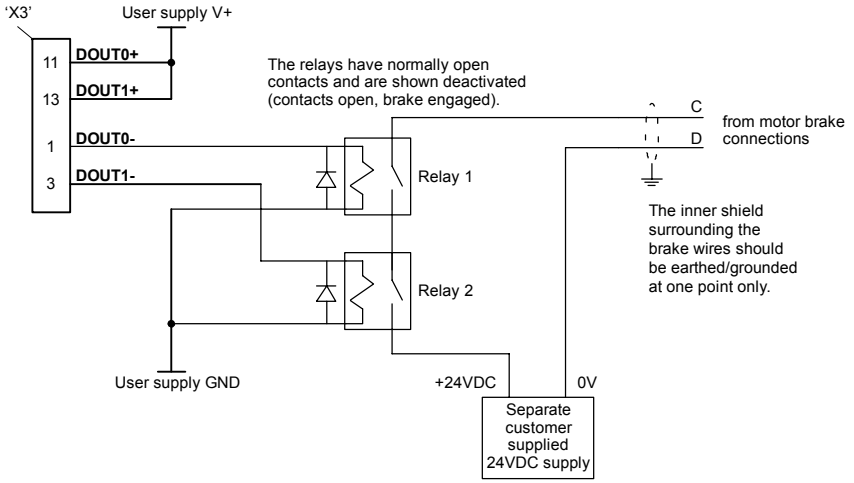



**Figure 10 - Motor brake control circuit**

This circuit uses the drive enable signal (configured using `DRIVEENABLEOUTPUT` to appear on DOUT0) in conjunction with DOUT1 (configured as the `MOTORBRAKEOUTPUT`). See the Mint help file for details. With this configuration, the following sequences can be used to control the brake.

To engage the brake:

- The motor is brought to rest under normal control;
- Relay 2 is deactivated, causing the brake to engage;
- The drive is disabled. This removes power from the motor and causes Relay 1 to be deactivated.

To disengage the brake:

- The drive is enabled, activating Relay 1;
- Power is applied to the motor to hold position under normal control;
- Relay 2 is activated, causing the brake to be disengaged.

It may be necessary to include a small delay, after Relay 2 has been activated, before starting motion. This delay will allow time for the relay contacts to engage and the brake to release.

**CAUTION**: The 24VDC power supply used to power the brake must be a separate supply as shown in Figure 10. Do not use the supply that is powering the MicroFlex e100 digital outputs. The brake wires often carry noise that could cause erratic drive operation or damage. The brake contacts must never be wired directly to the digital outputs. The relay(s) should be fitted with a protective flyback diode, as shown. The separate 24VDC supply used for the motor brake may also be used to power the relay in the thermal switch circuit (section 3.5.5).

## 3.6 Regeneration resistor (Dynamic Brake resistor)

An optional external regeneration resistor may be required to dissipate excess power from the internal DC bus during motor deceleration. The regeneration resistor must have a resistance of at least 39Ω, an inductance of less than 100µH, and a minimum power rating of 44W. Suitable regeneration resistors are listed in section A.1.4. The regeneration resistor output is conditionally short-circuit proof.

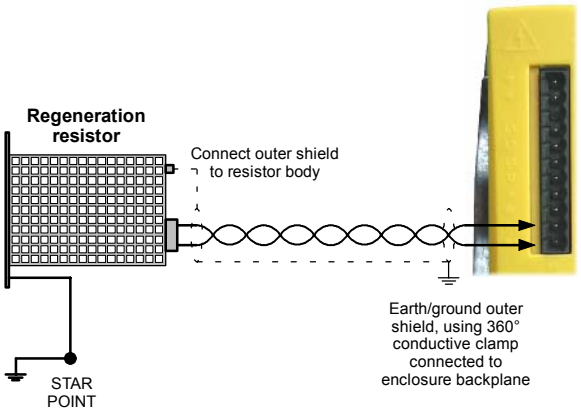



**Figure 11 - Regeneration resistor connections**

**DANGER**: Electrical shock hazard. DC bus voltages may be present at these terminals. A regeneration resistor may generate enough heat to ignite combustible materials. To avoid fire hazard, keep all combustible materials and flammable vapors away from the resistor.

## 4.1 Introduction

MicroFlex e100 supports many feedback options for use with linear and rotary motors, including incremental encoder, encoder with SSI (Synchronous Serial Interface), SinCos encoder, or EnDat absolute encoder. All suitable types of feedback device can be connected to the universal feedback interface available on connector X8.

There are some important considerations when wiring the feedback device:

- The feedback device wiring must be separated from power wiring.
- Where feedback device wiring runs parallel to power cables, they must be separated by at least 76mm (3 in)
- Feedback device wiring must cross power wires at right angles only.
- To prevent contact with other conductors or earths/grounds, unearthed/ungrounded ends of shields must often be insulated.
- Linear motors use two separate cables (encoder and Hall). The cores of these two cables will need to be wired to the appropriate pins of the 15-pin D-type mating connector.
- The inputs are not isolated.

### 4.1.1 Incremental encoder feedback

The incremental encoder connections (ABZ channels and Hall signals) are made using the 15-pin D-type female connector X8. The encoder inputs (CHA, CHB and CHZ) accept differential signals only. Twisted pairs must be used for each complementary signal pair e.g. CHA+ and CHA-. The Hall inputs may be used as differential inputs (recommended for improved noise immunity) or single ended inputs. When used as single ended inputs, leave the Hall U-, Hall V- and Hall W- pins unconnected. The overall cable shield (screen) must be connected to the metallic shell of the D-type connector. Connector X8 includes a 'Sense' pin, which is used to detect the voltage drop on long cable runs. This allows the MicroFlex e100 to increase the encoder supply voltage on pin 12 to maintain a 5V supply at the encoder (200mA max).


| Pin | Incremental encoder function |
|---|---|
| 1 | CHA+ |
| 2 | CHB+ |
| 3 | CHZ+ |
| 4 | Sense |
| 5 | Hall U- |
| 6 | Hall U+ |
| 7 | Hall V- |
| 8 | Hall V+ |
| 9 | CHA- |
| 10 | CHB- |
| 11 | CHZ- |
| 12 | +5V out |
| 13 | DGND |
| 14 | Hall W- |
| 15 | Hall W+ |

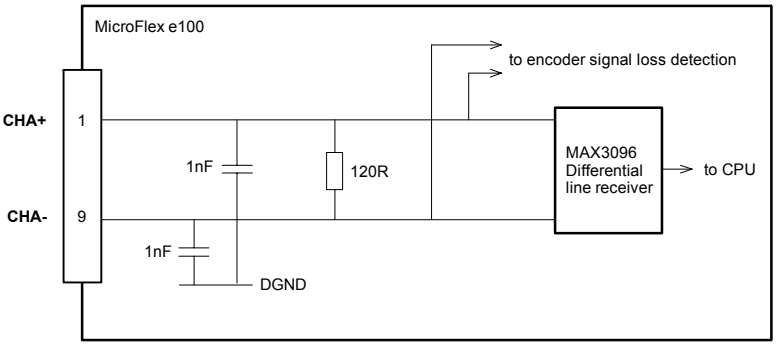



**Figure 12 - Encoder channel input circuit - Channel A shown**

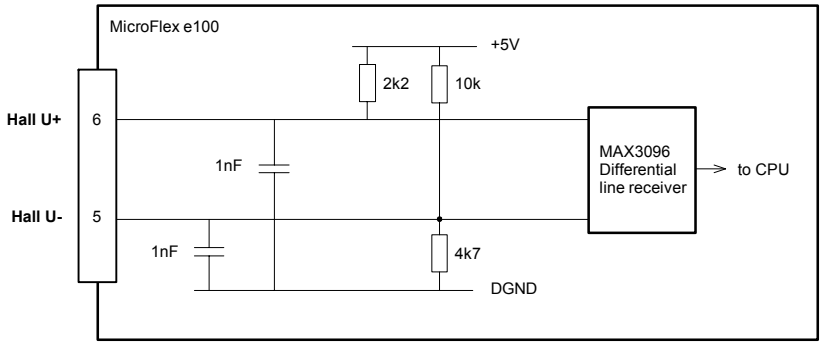



**Figure 13 - Hall channel input circuit - U phase shown**

#### 4.1.1.1 Encoder cable configuration - Baldor rotary motors

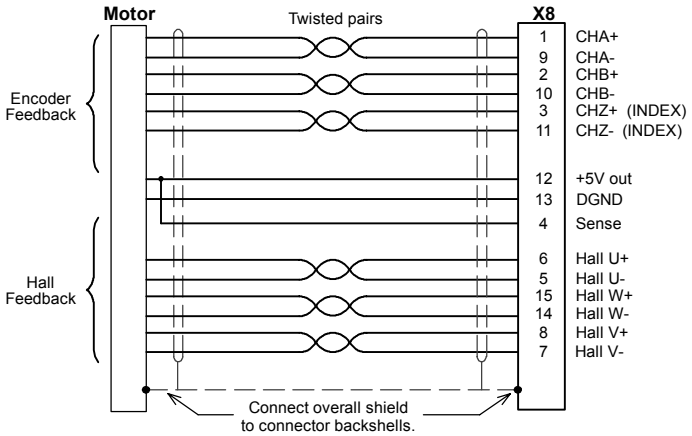



**Figure 14 - Encoder cable connections - rotary motors**

**Note:** If the Hall inputs are used as single ended inputs, leave the Hall U-, Hall V- and Hall W- pins unconnected; do not connect them to ground.

#### 4.1.1.2 Encoders without Halls

Incremental encoders without Hall feedback connections may be connected to the MicroFlex e100. However, if Hall connections are not present, it will be necessary for the MicroFlex e100 to perform an automatic phase search sequence each time it is powered. This will cause motor movement of up to 1 turn on rotary motors, or one pole-pitch on linear motors.

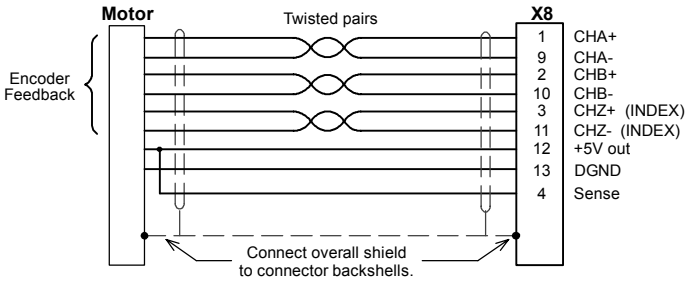



**Figure 15 - Encoder cable connections without halls - rotary motors**

#### 4.1.1.3 Halls-only feedback devices

Feedback devices using only Hall sensors may be connected to the MicroFlex e100. However, since there are no encoder connections, the MicroFlex e100 will not be able to perform smooth speed control or accurate positioning control.

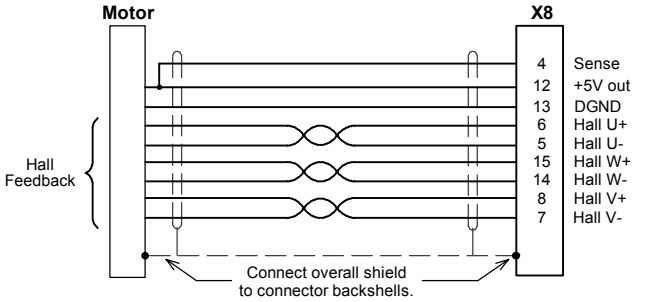



**Figure 16 - Halls-only feedback cable connections - rotary motors**

**Note:** If the Hall inputs are used as single ended inputs, leave the Hall U-, Hall V- and Hall W- pins unconnected; do not connect them to ground.

#### 4.1.1.4 Encoder cable pin configuration - Baldor linear motors

Baldor linear motors use two separate cables (encoder and Hall). The cores of these two cables must be wired to the appropriate pins of the 15-pin D-type mating connector (supplied):

| Signal name | MicroFlex e100 X8 pin | Encoder cable internal wire colors |
|---|---|---|
| **CHA+** | 1 | Please refer to MN1800 *Linear Motors Installation & Operating Manual* for details. |
| **CHA-** | 9 | |
| **CHB+** | 2 | |
| **CHB-** | 10 | |
| **CHZ+** | 3 | |
| **CHZ-** | 11 | |
| | | **Baldor Hall cable internal wire colors** |
| **Hall U+** | 6 | White |
| **Hall V+** | 8 | Red |
| **Hall W+** | 15 | Black |
| **+5V out** | 12 | Brown |
| **Hall GND** | 13 | Green |

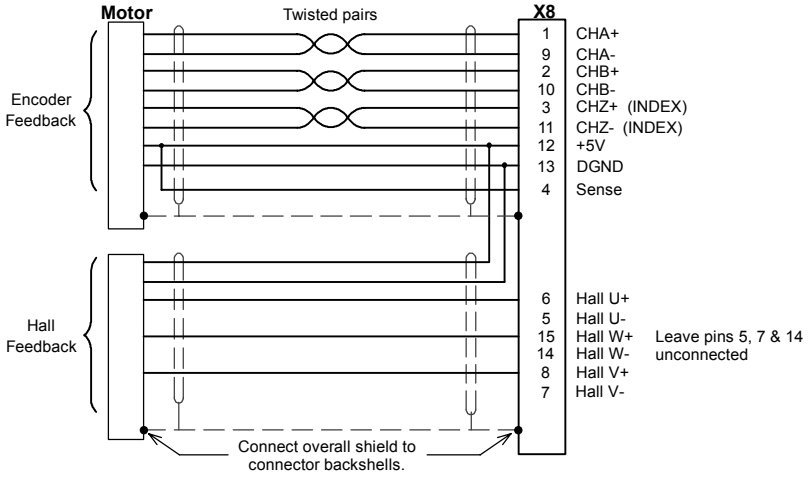
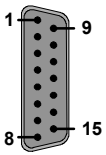



**Figure 17 - Encoder cable connections - linear motors**

## 4.1.2 SSI feedback

The SSI (Synchronous Serial Interface) encoder interface is specifically designed for use with Baldor SSI motors, which incorporate a custom Baumer SSI encoder. Correct operation with other SSI interfaces cannot be guaranteed. The SSI encoder connections are made using the 15-pin D-type female connector X8. Twisted pair cables must be used for the complementary signal pairs e.g. Data+ and Data-. The overall cable shield (screen) must be connected to the metallic shell of the D-type connector. Connector X8 includes a 'Sense' pin, which is used to detect the voltage drop on long cable runs. This allows the MicroFlex e100 to increase the encoder supply voltage on pin 12 to maintain a 5V supply at the encoder (200mA max).




| Pin | SSI function |
|---|---|
| 1 | Data+ |
| 2 | Clock+ |
| 3 | *(NC)* |
| 4 | Sense |
| 5 | *(NC)* |
| 6 | *(NC)* |
| 7 | *(NC)* |
| 8 | *(NC)* |
| 9 | Data- |
| 10 | Clock- |
| 11 | *(NC)* |
| 12 | +5V out |
| 13 | DGND |
| 14 | *(NC)* |
| 15 | *(NC)* |

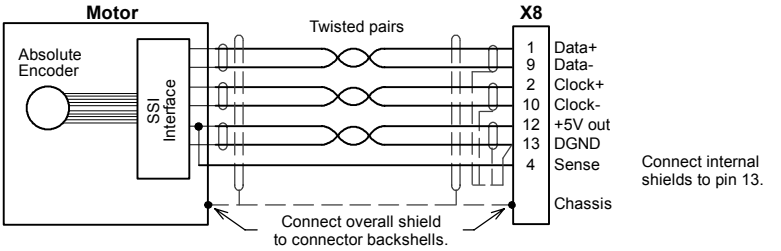



**Figure 18 - SSI encoder cable connections**

#### 4.1.2.1 SSI cable pin configuration

Figure 19 shows the pin configuration for a typical Baldor SSI feedback cable, part number CBL025SF-S2

| Signal name | MicroFlex e100 X8 pin | Motor / cable pin | Baldor SSI cable internal wire colors |
|---|---|---|---|
| **+5V out** | 12 | 1 | Red |
| **Sense** | 4 | 9 | Orange |
| **DGND** | 13 | 2 | Blue |
| **Clock+** | 2 | 3 | Green |
| **Clock-** | 10 | 4 | Yellow |
| **Data+** | 1 | 5 | Pink |
| **Data-** | 9 | 6 | Grey |

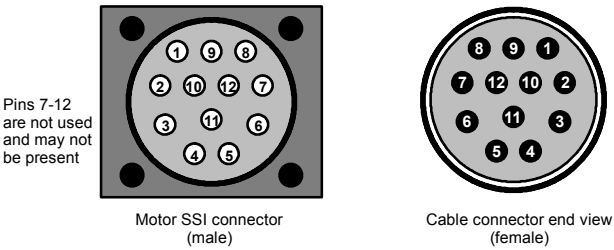
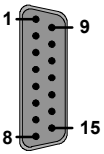



**Figure 19 - Baldor motor SSI feedback cable pin configuration**

The maximum recommended cable length is 30.5m (100ft).

### 4.1.3 SinCos feedback

The SinCos connections (Sin and Cos incremental channels only) are made using the 15-pin D-type female connector X8. Twisted pair cables must be used for the complementary signal pairs e.g. Sin+ and Sin-. The overall cable shield (screen) must be connected to the metallic shell of the D-type connector. Connector X8 includes a 'Sense' pin, which is used to detect the voltage drop on long cable runs. This allows the MicroFlex e100 to increase the encoder supply voltage on pin 12 to maintain a 5V supply at the encoder (200mA max).




| Pin | SinCos function |
|---|---|
| 1 | *(NC)* |
| 2 | *(NC)* |
| 3 | *(NC)* |
| 4 | Sense |
| 5 | Sin- |
| 6 | Sin+ |
| 7 | Cos- |
| 8 | Cos+ |
| 9 | *(NC)* |
| 10 | *(NC)* |
| 11 | *(NC)* |
| 12 | +5V out |
| 13 | DGND |
| 14 | *(NC)* |
| 15 | *(NC)* |

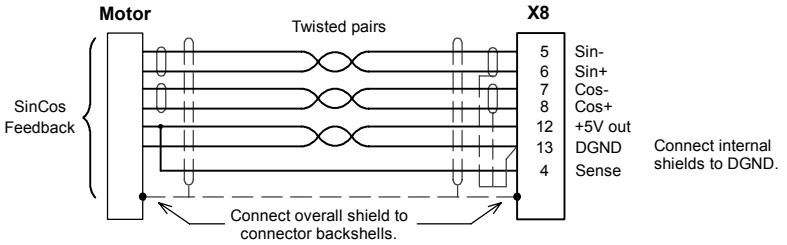
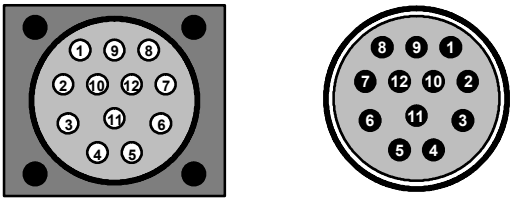



**Figure 20 - SinCos cable connections**

#### 4.1.3.1 SinCos cable pin configuration

Figure 21 shows the pin configuration for a typical Baldor SinCos feedback cable, part number CBL025SF-D2.

| Signal name | MicroFlex e100 X8 pin | Motor / cable pin | Baldor EnDat / SinCos cable internal wire colors |
|---|---|---|---|
| *(Not used)* | 9 | 1 | Brown / White |
| **Sin+** | 6 | 2 | Green |
| **Cos+** | 8 | 4 | Purple |
| *(Not used)* | 10 | 5 | Pink / Black |
| *(Not used)* | 2 | 7 | Pink |
| **Cos-** | 7 | 8 | Purple / White |
| **Sense** | 4 | 9 | Orange |
| **+5V out** | 12 | 9 | Red |
| **DGND** | 13 | 10 | Blue |
| **Sin-** | 5 | 11 | Green / White |
| *(Not used)* | 1 | 12 | Brown |




Motor SinCos connector (male)

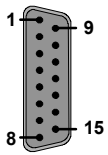
Cable connector end view (female)

**Figure 21 - Baldor motor SinCos feedback cable pin configuration**

The maximum recommended cable length is 30.5m (100ft).

### 4.1.4 EnDat (absolute encoder) feedback

The absolute encoder interface supports both incremental and absolute (multi and single turn) feedback using EnDat technology. It is possible to read and write information to the encoder. The absolute encoder connections are made using the 15-pin D-type female connector X8. Twisted pair cables must be used for the complementary signal pairs e.g. Sin+ and Sin-. The overall cable shield (screen) must be connected to the metallic shell of the D-type connector. Connector X8 includes a 'Sense' pin, which is used to detect the voltage drop on long cable runs. This allows the MicroFlex e100 to increase the encoder supply voltage on pin 12 to maintain a 5V supply at the encoder (200mA max). Version 2.2 EnDat encoders do not use the Sin and Cos channels.




| Pin | Absolute encoder function |
|---|---|
| 1 | Data+ |
| 2 | Clock+ |
| 3 | *(NC)* |
| 4 | Sense |
| 5 | Sin- |
| 6 | Sin+ |
| 7 | Cos- |
| 8 | Cos+ |
| 9 | Data- |
| 10 | Clock- |
| 11 | *(NC)* |
| 12 | +5V out |
| 13 | DGND |
| 14 | *(NC)* |
| 15 | *(NC)* |

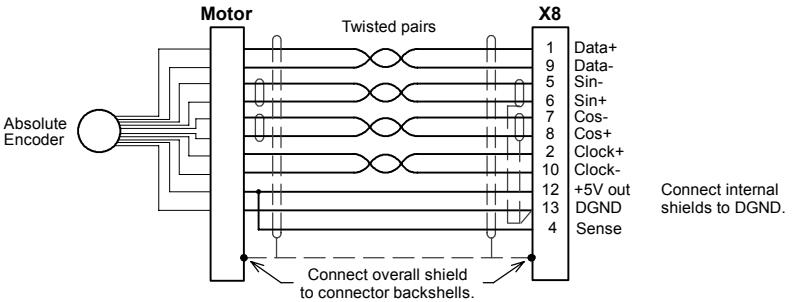
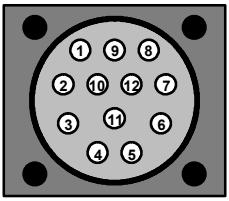



**Figure 22 - Absolute encoder cable connections**

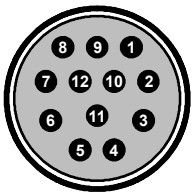
#### 4.1.4.1 Absolute encoder cable pin configuration

Figure 23 shows the pin configuration for a typical Baldor absolute encoder feedback cable, part number CBL025SF-D2.

| Signal name | MicroFlex e100 X8 pin | Motor / cable pin | Baldor EnDat / SinCos cable internal wire colors |
|---|---|---|---|
| **Data -** | 9 | 1 | Brown / White |
| **Sin+** | 6 | 2 | Green |
| **Cos+** | 8 | 4 | Purple |
| **Clock-** | 10 | 5 | Pink / Black |
| **Clock+** | 2 | 7 | Pink |
| **Cos-** | 7 | 8 | Purple / White |
| **Sense** | 4 | 9 | Orange |
| **+5V out** | 12 | 9 | Red |
| **DGND** | 13 | 10 | Blue |
| **Sin-** | 5 | 11 | Green / White |
| **Data +** | 1 | 12 | Brown |




Motor absolute encoder connector (male)




Cable connector end view (female)

**Figure 23 - Baldor rotary motor absolute encoder cable pin configuration**

The maximum recommended cable length is 30.5m (100ft).

## 5.1 Introduction

This section describes the various digital input and output capabilities of the MicroFlex e100, with descriptions of each of the connectors on the front panel.

The following conventions are used to refer to the inputs and outputs:

I/O . . . . . Input / Output
DIN . . . . . Digital Input
DOUT . . . . . Digital Output

## 5.2 Digital I/O

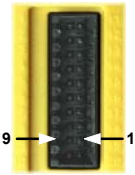
The MicroFlex e100 provides as standard:

- 3 general purpose digital inputs.
- 1 dedicated drive enable input.
- 1 general purpose digital output.
- 1 general purpose / drive status output.

The general purpose digital inputs can be configured for typical input functions:

- Error input
- Reset input
- Stop input
- Forward / reverse limit input
- Home input.

### 5.2.1 Drive enable input




| | |
|---|---|
| **Location** | Connector X3, pins 9 & 19<br>(Mating connector: Weidmüller Minimate B2L 3.5/20) |
| **Name** | Drive enable |
| **Description** | Dedicated drive enable input.<br>Nominal input voltage: +24VDC<br>(input current not to exceed 50mA)<br>Sampling interval: 1ms |

The drive enable input is buffered by a TLP280 opto-isolator, allowing the input signal to be connected with either polarity.

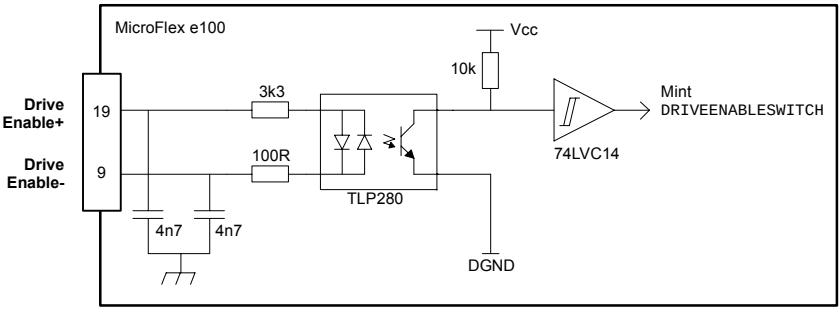



**Figure 24 - Drive enable input circuit**

In normal use, the drive enable input controls the enabled status of the drive. However, when the MicroFlex e100 is connected to Mint WorkBench, additional methods are available for controlling the drive enable status. In all cases, the drive enable input must be active and there must be no errors present before the MicroFlex e100 can be enabled.

- The drive enable button on the motion toolbar toggles the enable/disable status. Alternatively, the Mint command `DRIVEENABLE.0=1` can be used in the command window to enable the MicroFlex e100; `DRIVEENABLE.0=0` will disable the MicroFlex e100.

- The Tools, Reset Controller menu item will clear errors and enable the MicroFlex e100. Alternatively, the Mint command `RESET.0` can be used in the command window to perform the same action.

The state of the drive enable input is displayed in the Mint WorkBench Spy window. Alternatively, the state of the drive enable input can be read (but not set) using the Mint command `Print DRIVEENABLESWITCH` in the command window. See the Mint help file for details.

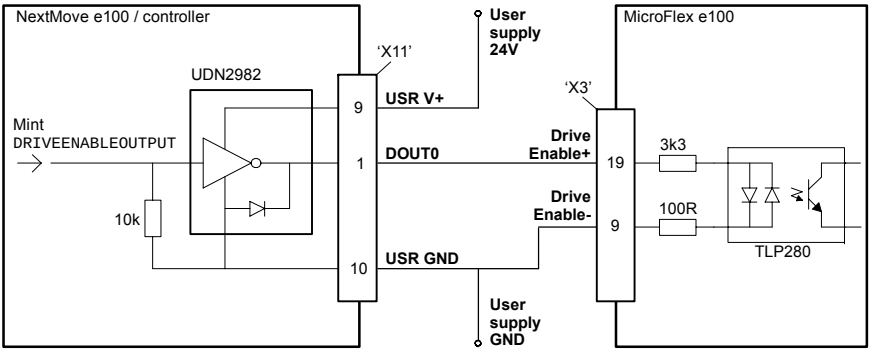
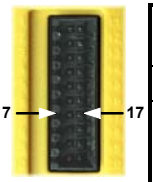



**Figure 25 - Drive enable input - typical connection from a Baldor NextMove e100**

## 5.2.2 General purpose digital input DIN0




| | |
|---|---|
| **Location** | Connector X3, pins 7 & 17<br>(Mating connector: Weidmüller Minimate B2L 3.5/20) |
| **Name** | DIN0 |
| **Description** | General purpose opto-isolated digital input.<br>Nominal input voltage: +24VDC<br>(input current not to exceed 50mA)<br>Sampling interval: 1ms |

This general purpose digital input is buffered by a TLP280 opto-isolator, allowing the input signal to be connected with either polarity. The state of the digital input is displayed in the Mint WorkBench Spy window. The input can be can be configured for different user definable functions.

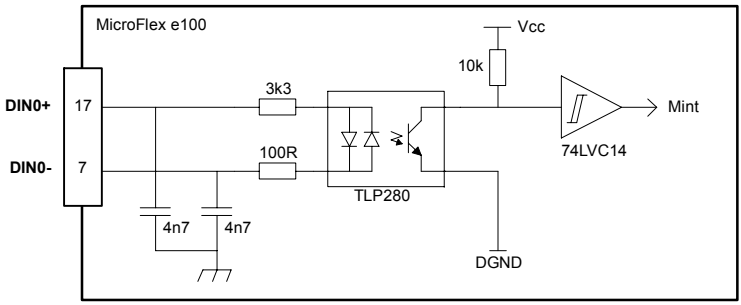



**Figure 26 - General purpose digital input circuit**

When the MicroFlex e100 is connected to Mint WorkBench, the digital input can be configured using the Digital I/O tool. Alternatively, Mint keywords including `RESETINPUT`, `ERRORINPUT` and `STOPINPUT` can be used in the command window. The state of the digital input can be viewed using the Mint WorkBench Spy window's Axis tab. See the Mint help file for details.

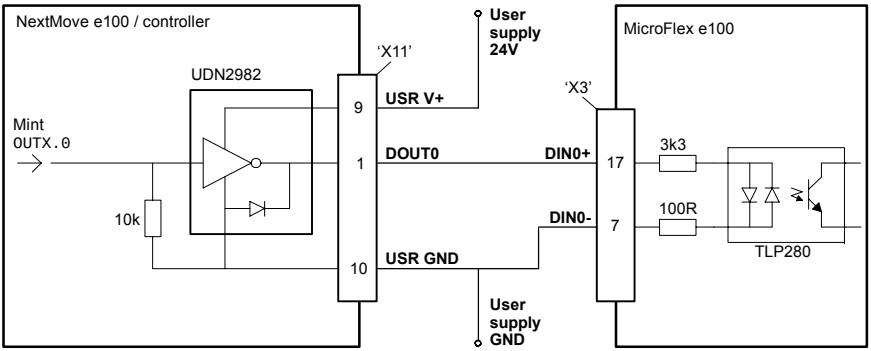
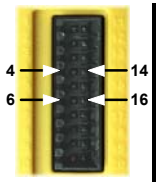



**Figure 27 - Digital input - typical connection from a Baldor NextMove e100**

### 5.2.3 General purpose digital inputs DIN1 & DIN2




| | |
|---|---|
| **Location** | Connector X3, pins 6 & 16 (DIN1), 4 & 14 (DIN2)<br>(Mating connector: Weidmüller Minimate B2L 3.5/20) |
| **Name** | DIN1, DIN2 |
| **Description** | General purpose fast opto-isolated digital inputs.<br>Nominal input voltage: +24VDC<br>(input current not to exceed 20mA)<br>Maximum input frequency: 1 MHz maximum |

These general purpose fast digital inputs are buffered by a TLP115 opto-isolator, allowing the input signal to be connected with either polarity. The state of the digital input is displayed in the Mint WorkBench Spy window. The inputs can be can be configured for different user definable functions.

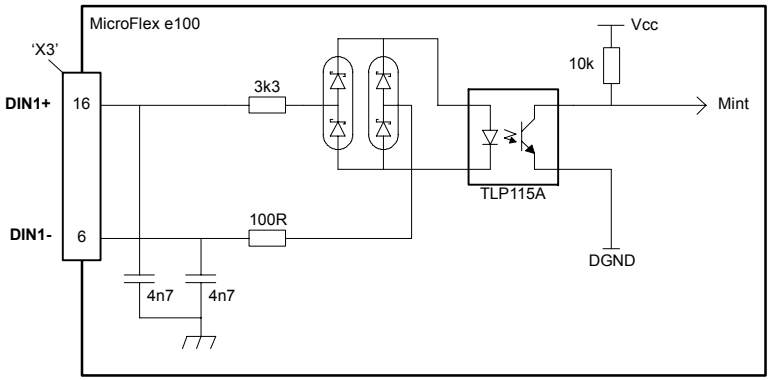



**Figure 28 - General purpose fast digital input circuit**

When the MicroFlex e100 is connected to Mint WorkBench, the digital input can be configured using the Digital I/O tool. Alternatively, the Mint keywords `RESETINPUT`, `ERRORINPUT` and `STOPINPUT` can be used in the command window. The state of the digital input can be viewed using the Spy window's Axis tab. See the Mint help file for details.

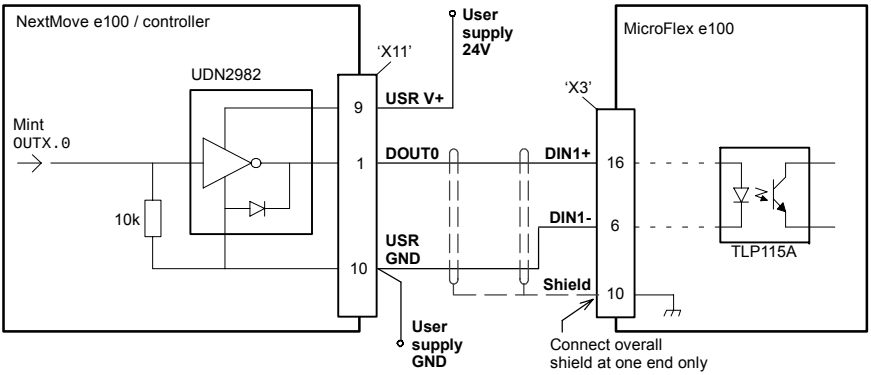



**Figure 29 - Digital input - typical connection from a Baldor NextMove e100**

## 5.2.4 Special functions on inputs DIN1 and DIN2

DIN1 and DIN2 can be configured to perform special functions.

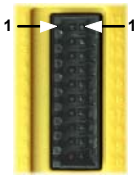
### 5.2.4.1 Fast position capture

DIN1 or DIN2 can be configured using the FASTSELECT keyword to become a fast latch input. This allows the position of the axis to be captured in real-time and read using the Mint keyword FASTPOS. or FASTENCODER. The input can configured using the FASTLATCHEDGE keyword to be triggered either on a rising or falling edge. Further control of position capture is provided by the FASTLATCH and FASTLATCHMODE keywords.

The maximum latency to read the fast position depends on the feedback device. For an incremental encoder, the latency is approximately 150 - 300ns. For other feedback devices latency may be up to 62.5µs, resulting from the 16kHz sampling frequency used for these types of feedback device. The fast interrupt will be latched on a pulse width of about 30µs, although a width of 100µs is recommended to ensure capture. To prevent subsequent inputs causing the captured value to be overwritten, the interrupt is latched in software.

**Note:** The fast inputs are particularly sensitive to noise, so inputs must use shielded twisted pair cable. Do not connect mechanical switches, relay contacts or other sources liable to signal 'bounce' directly to the fast inputs. This could cause unwanted multiple triggering.

## 5.2.5 General purpose / status output DOUT0




| | |
|---|---|
| **Location** | Connector X3, pins 1 & 11<br>(Mating connector: Weidmüller Minimate B2L 3.5/20) |
| **Name** | Status / DOUT0 |
| **Description** | General purpose opto-isolated digital output<br>Output current: 100mA maximum<br>User supply +28VDC maximum<br>Update interval: 1ms |

The optically isolated general purpose / status output is designed to source current from the user supply as shown in Figure 30. The PS2562L has a maximum power dissipation of 200mW at 25°C. The maximum saturated voltage across the outputs when active is 1.0VDC, so it can be used as a TTL compatible output.

The output includes a self-resetting fuse that operates at approximately 200mA. The fuse may take up to 20 seconds to reset after the load has been removed. If the output is used to directly drive a relay, a suitably rated diode must be fitted across the relay coil, observing the correct polarity. This is to protect the output from the back-EMF generated by the relay coil when it is de-energized. The sense of the output can be configured in Mint WorkBench, and its state is displayed in the Spy window.

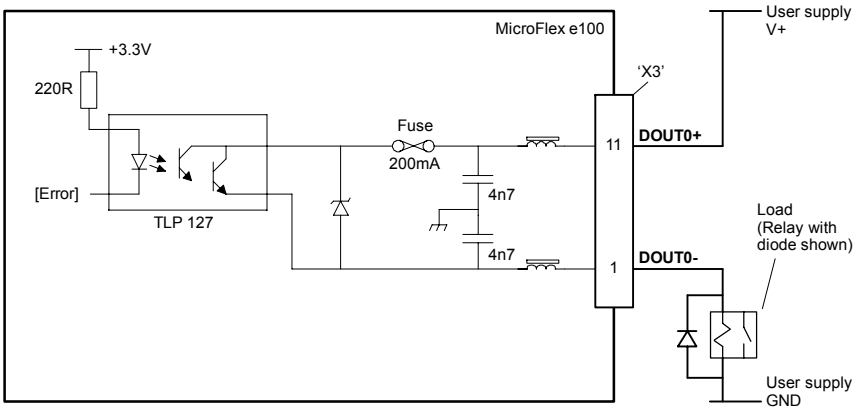



**Figure 30 - DOUT0 output circuit**

By default, DOUT0 is configured as an error status output, which becomes inactive in the event of an error. When the MicroFlex e100 is connected to Mint WorkBench, the active level of the output can be configured using the Digital I/O tool. Alternatively, the Mint keyword `OUTPUTACTIVELEVEL` can be used in the command window. See the Mint help file for details.

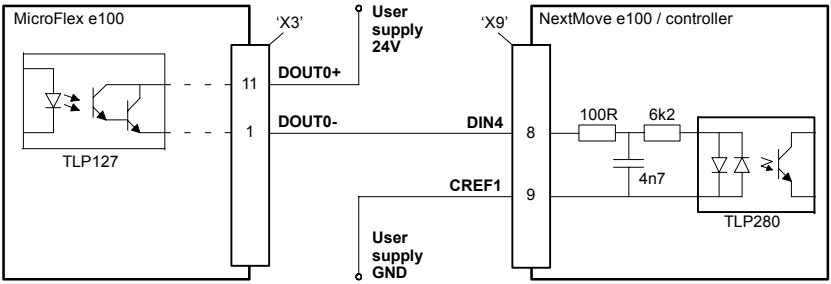
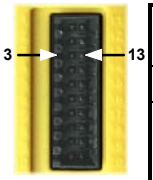



**Figure 31 - DOUT0 - typical connections to a Baldor NextMove e100**

## 5.2.6 General purpose output DOUT1




| | |
|---|---|
| **Location** | Connector X3, pins 3 & 13<br>(Mating connector: Weidmüller Minimate B2L 3.5/20) |
| **Name** | DOUT1 |
| **Description** | General purpose opto-isolated digital output<br>Output current: 100mA maximum<br>User supply: +28VDC maximum<br>Update interval: 1ms |

The optically isolated general purpose output is designed to source current from the user supply as shown in Figure 30. The PS2562L has a maximum power dissipation of 200mW at 25°C. The maximum saturated voltage across the outputs when active is 1.0VDC, so it can be used as a TTL compatible output.

The output includes a self-resetting fuse that operates at approximately 200mA. The fuse may take up to 20 seconds to reset after the load has been removed. If the output is used to directly drive a relay, a suitably rated diode must be fitted across the relay coil, observing the correct polarity. This is to protect the output from the back-EMF generated by the relay coil when it is de-energized. The sense of the output can be configured in Mint WorkBench, and its state is displayed in the Spy window.

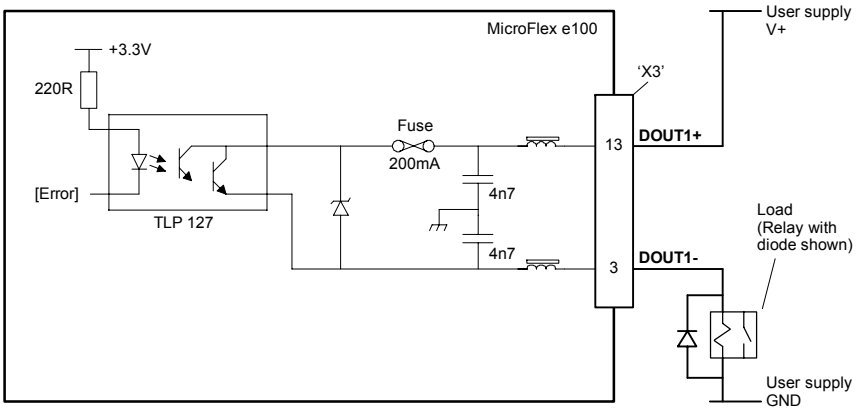



**Figure 32 - DOUT1 output circuit**

When the MicroFlex e100 is connected to Mint WorkBench, the active level of the output can be configured using the Digital I/O tool. Alternatively, the Mint keyword `OUTPUTACTIVELEVEL` can be used in the command window. See the Mint help file for details.

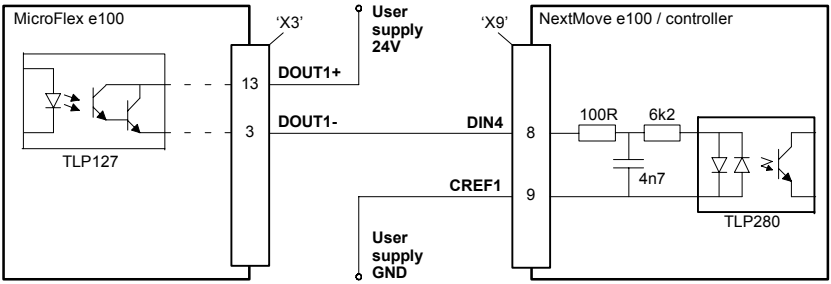
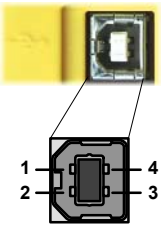



**Figure 33 - DOUT1 - typical connections to a Baldor NextMove e100**

# 5.3 USB communication

## 5.3.1 USB port




| Location | USB<br>Mating connector: USB Type B (downstream) plug | |
|---|---|---|
| **Pin** | **Name** | **Description** |
| 1 | VBUS | USB +5V |
| 2 | D- | Data- |
| 3 | D+ | Data+ |
| 4 | GND | Ground |

The USB connector is used to connect the MicroFlex e100 to a PC running Mint WorkBench. The MicroFlex e100 is a self-powered, USB 1.1 (12Mbps) compatible device. If it is connected to a slower USB1.0 host PC or hub, communication speed will be limited to the USB1.0 specification (1.5Mbps). If it is connected to a faster USB2.0 (480Mbps) host PC or hub, communication speed will remain at the USB1.1 specification of the MicroFlex e100.

Ideally, the MicroFlex e100 should be connected directly to a USB port on the host PC. If it is connected to a hub shared by other USB devices, communication could be affected by the activity of the other devices. A 2m (6.5 ft) standard USB cable is supplied. The maximum recommended cable length is 5m (16.4 ft).

## 5.4 Ethernet interface

The Ethernet interface provides TCP/IP and ETHERNET Powerlink (EPL) networking capabilities.

### 5.4.1 TCP/IP

Transmission Control Protocol / Internet Protocol (TCP/IP) is a common set of protocols used to transfer information between devices over a network, including the internet. TCP enables two devices to establish a connection, and guarantees the delivery of packets (datagrams) of information in the correct order. IP specifies the format of the individual packets (which includes the destination address of the receiving device) but has no influence on whether the packet is delivered correctly.

TCP/IP allows the MicroFlex e100 to support standard Ethernet communication with a host PC running Mint WorkBench. The connection uses Baldor's high level ICM (Immediate Command Mode) protocol to allow Mint commands, Mint programs and even firmware to be sent to the controller over the Ethernet network.

When operating in standard Ethernet mode, TCP/IP cannot be used to communicate with a controller on a daisy-chained network. This is due to cumulative timing errors caused by each controller's internal hub. It is necessary to connect the host PC to the controller either directly or via a single hub, as shown in Figure 34:

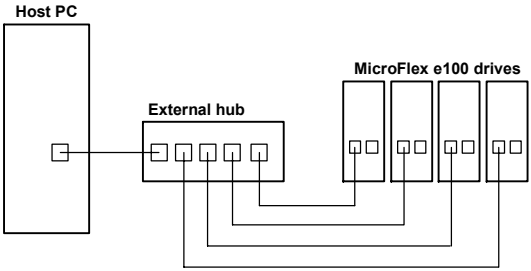



**Figure 34 - Connecting to drives using TCP/IP in standard Ethernet mode**

When operating in EPL mode, in conjunction with an EPL compatible router, the host PC *can* use TCP/IP to communicate with controllers on a daisy-chained network. In this situation, the router will use TCP/IP only within EPL's asynchronous time slots. See the Mint help file for further details.

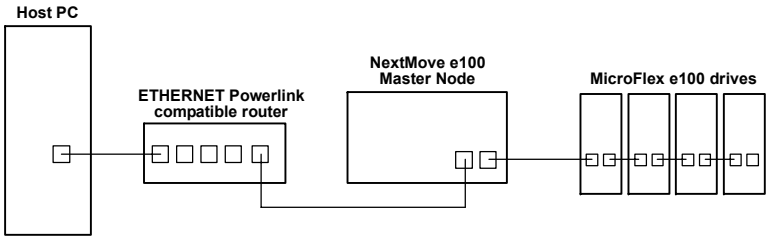



**Figure 35 - Connecting to daisy-chained drives using TCP/IP and EPL mode**

## 5.4.2 ETHERNET Powerlink

MicroFlex e100 supports the deterministic ETHERNET Powerlink (EPL) protocol. This protocol provides very precise and predictable 'real-time' communication over a 100Mbit/s (100Base-T) Fast Ethernet (IEEE 802.3u) connection. This makes it suitable for the transmission of control and feedback signals between the MicroFlex e100 and other EPL enabled controllers such as NextMove e100. The EPL protocol implemented in Mint is based on the CANopen DS402 Device Profile for Drives and Motion Control.

MicroFlex e100 incorporates a built-in repeating hub, providing two ports for connection to other equipment. This allows nodes to be connected as a 'daisy-chain' network of up to 10 nodes, avoiding the need for additional hubs. If the network comprises more than 10 nodes, an external hub must be used. The structure of the physical network is informal so does not need to reflect the logical relationship between nodes. Ethernet switches must not be used in EPL networks as their timing cannot be guaranteed.

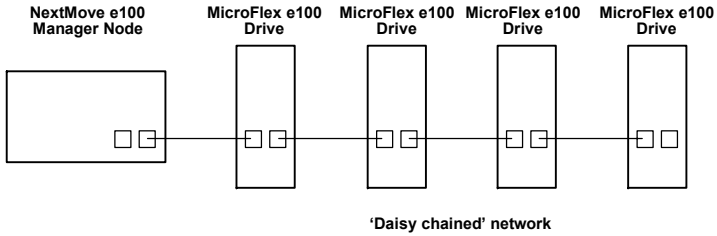



**Figure 36 - Simple daisy-chained EPL network**

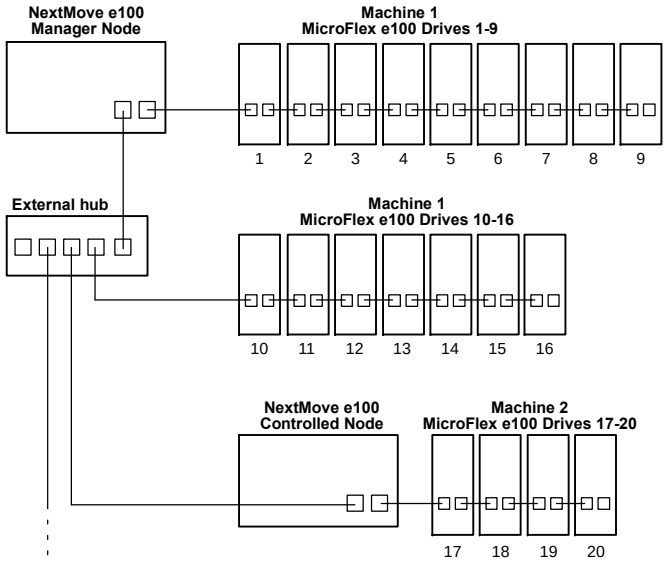
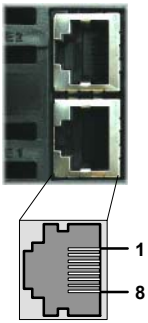



**Figure 37 - Example multi-branch EPL network**

### 5.4.3 Ethernet connectors

Ethernet connections are made using the identical RJ45 Ethernet receptacles.




| Location | E1 & E2 | |
|---|---|---|
| **Pin** | **Name** | **Description** |
| 1 | TX+ | Transmit+ |
| 2 | TX- | Transmit- |
| 3 | RX+ | Receive+ |
| 4 | - | *(NC)* |
| 5 | - | *(NC)* |
| 6 | RX- | Receive- |
| 7 | - | *(NC)* |
| 8 | Shield | Shield connection |

To connect the MicroFlex e100 to other EPL devices, ordinary shielded CAT5 Ethernet cables are used. Cables may be up to 100m (328 ft) long. Two varieties of CAT5 cable are available; 'straight' or 'crossed'. Straight cables have the TX pins of the connector at one end of the cable wired to the TX pins of the RJ45 connector at the other end of the cable. Crossover cables have the TX pins of the connector at one end of the cable wired to the RX pins of the RJ45 connector at the other end of the cable.

Provided the network consists of only Baldor EPL controllers and drives (and any hub), straight or crossed cables may be used. This is because many Ethernet devices, including hubs and all Baldor EPL products, incorporate Auto-MDIX switching technology which automatically compensates for the wiring of the straight cable. However, if other manufacturer's EPL nodes are included in the network, crossover cables should be used as recommended by the ETHERNET Powerlink Standardization Group (EPSG).

The MicroFlex e100 Ethernet interface is galvanically isolated from the rest of the MicroFlex e100 circuitry by magnetic isolation modules incorporated in each of the Ethernet connectors. This provides protection up to 1.5kV. The connector/cable screen is connected directly to the chassis earth of the MicroFlex e100. Termination components are incorporated in each of the Ethernet connectors, so no further termination is required.

The EPL network supports the 100Base-TX (100Mbit/s) system only, so attempting to connect slower 10Base-T (10Mbit/s) nodes will cause a network error.

## 5.5 CAN interface

The CAN bus is a serial based network originally developed for automotive applications, but now used for a wide range of industrial applications. It offers low-cost serial communications with very high reliability in an industrial environment; the probability of an undetected error is $4.7x10^{-11}$. It is optimized for the transmission of small data packets and therefore offers fast update of I/O devices (peripheral devices) connected to the bus.

The CAN protocol only defines the physical attributes of the network, i.e. the electrical, mechanical, functional and procedural parameters of the physical connection between devices. The higher level network functionality on MicroFlex e100 is defined by the CANopen protocol, one of the most used standards for machine control.

### 5.5.1 CAN connector


| Location | CAN<br>Mating connector: 9-pin female D-type | |
|---|---|---|
| **Pin** | **Name** | **Description** |
| 1 | - | *(NC)* |
| 2 | CAN- | CAN channel negative |
| 3 | CAN GND | Ground/earth reference for CAN signals |
| 4 | - | *(NC)* |
| 5 | Shield | Shield connection |
| 6 | CAN GND | Ground/earth reference for CAN signals |
| 7 | CAN+ | CAN channel positive |
| 8 | - | *(NC)* |
| 9 | CAN V+ | CAN power V+ (12-24V) |

### 5.5.2 CAN wiring

A very low error bit rate over CAN can only be achieved with a suitable wiring scheme, so the following points should be observed:

- The two-wire data bus line may be routed parallel, twisted and/or shielded, depending on EMC requirements. Baldor recommend a twisted pair cable with the shield/screen connected to the connector backshell, in order to reduce RF emissions and provide immunity to conducted interference.
- The bus must be terminated at both ends only (not at intermediate points) with resistors of a nominal value of 120Ω. This is to reduce reflections of the electrical signals on the bus, which helps a node to interpret the bus voltage levels correctly. If the MicroFlex e100 is at the end of the network then ensure that a 120Ω resistor is fitted (normally inside the D-type connector).
- All cables and connectors should have a nominal impedance of 120Ω. Cables should have a length related resistance of 70mΩ/m and a nominal line delay of 5ns/m.

- The maximum bus length depends on the bit-timing configuration (baud rate). The table opposite shows the approximate maximum bus length (worst-case), assuming 5ns/m propagation delay and a total effective device internal in-out delay of 210ns at 1Mbit/s, 300ns at 500 - 250Kbit/s, 450ns at 125Kbit/s and 1.5ms at 50 - 10Kbit/s.

  (1) For bus lengths greater than about 1000m, bridge or repeater devices may be needed.

| CAN Baud Rate | Maximum Bus Length |
|---|---|
| 1Mbit/s | 25m |
| 500Kbit/s | 100m |
| 250Kbit/s | 250m |
| 125Kbit/s | 500m |
| 100Kbit/s | 600m |
| 50Kbit/s | 1000m |
| 20Kbit/s | 2500m(1) |
| 10Kbit/s | 5000m(1) |

- The compromise between bus length and CAN baud rate must be determined for each application. The CAN baud rate can be set using the BUSBAUD keyword. It is essential that all nodes on the network are configured to run at the same baud rate.
- The wiring topology of a CAN network should be as close as possible to a single line/bus structure. However, stub lines are allowed provided they are kept to a minimum (<0.3m at 1Mbit/s).
- The 0V connection of all of the nodes on the network must be tied together through the CAN cabling. This ensures that the CAN signal levels transmitted by MicroFlex e100 or CAN peripheral devices are within the common mode range of the receiver circuitry of other nodes on the network.

#### 5.5.2.1 Opto-isolation

On the MicroFlex e100, the CAN channel is opto-isolated. A voltage in the range 12-24V must be applied between pin 9 (+24V) and pin 3 or 6 (0V) of the CAN connector. From this supply, an internal voltage regulator provides the 5V at 100mA required for the isolated CAN circuit. CAN cables supplied by Baldor are 'category 5' and have a maximum current rating of 1A, so the maximum number of MicroFlex e100 units that may be used on one network is limited to ten.

### 5.5.3 CANopen

Baldor have implemented a CANopen protocol in Mint (based on the 'Communication Profile' CiA DS-301) which supports both direct access to device parameters and time-critical process data communication. The MicroFlex e100 complies with CANopen slave device profile DS402, and can be a DS401 or DS403 master device (with limited functionality). It is able to support and communicate with a variety of devices including:

- Any third party digital and analog I/O device that is compliant with the 'Device Profile for Generic I/O Modules' (CiA DS-401).
- Baldor HMI (Human Machine Interface) operator panels, which are based on the 'Device Profile for Human Machine Interfaces' (DS403).
- Other Baldor controllers with CANopen support for peer-to-peer access using extensions to the CiA specifications (DS301 and DS302).

The functionality and characteristics of all Baldor CANopen devices are defined in individual standardized (ASCII format) Electronic Data Sheets (EDS) which can be found on the Baldor Motion Toolkit CD supplied with your product, or downloaded from www.supportme.net.
Figure 38 shows a typical CANopen network with a NextMove e100 manager node, one MicroFlex e100 slave node and a Baldor HMI operator panel:

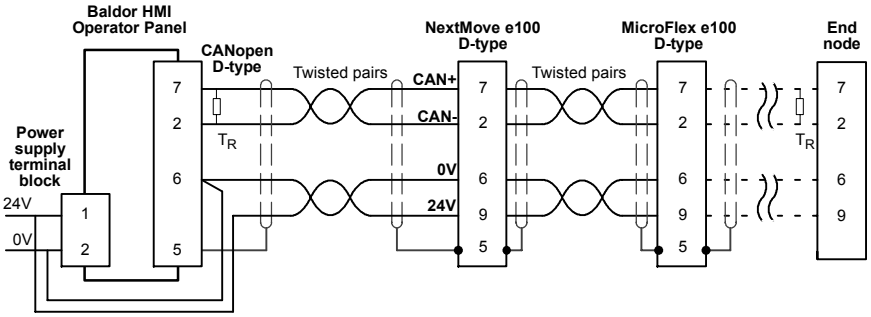



**Figure 38 - Typical CANopen network connections**

**Note:** The MicroFlex e100 CAN channel is opto-isolated, so a voltage in the range 12-24V must be applied between pin 9 and pin 6 of the CAN connector.

The configuration and management of a CANopen network must be carried out by a single node acting as the network manager (for example NextMove e100), or by a third party CANopen manager device.

Up to 126 CANopen nodes (node IDs 2 to 127) can be added to the network by the manager node using the Mint `NODESCAN` keyword. If successful, the nodes can then be connected to using the Mint `CONNECT` keyword. Any network and node related events can then be monitored using the Mint `BUS1` event.

**Note:** All CAN related Mint keywords are referenced to CANopen using the 'bus' dot parameter. For CANopen the 'bus' dot parameter must be set to 1.

Please refer to the Mint help file for further details on CANopen, Mint keywords and dot parameters.

# 5.6 Other I/O

## 5.6.1 Node ID selector switches


The MicroFlex e100 has two selector switches which determine the unit's node ID on EPL networks. Each switch has 16 positions, allowing selection of the hexadecimal values 0 - F. In combination, the two switches allow node IDs of 0 - 255 (hexadecimal FF) to be selected. The switch labelled 'HI' sets the high nibble (half byte), and the switch labelled 'LO' sets the low nibble. The following table lists all node IDs from 0 to 255 with the equivalent HI and LO switch settings:

| Node ID | HI | LO | Node ID | HI | LO | Node ID | HI | LO | Node ID | HI | LO |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 0 | 0 | **64** | 4 | 0 | **128** | 8 | 0 | **192** | C | 0 |
| **1** | 0 | 1 | **65** | 4 | 1 | **129** | 8 | 1 | **193** | C | 1 |
| **2** | 0 | 2 | **66** | 4 | 2 | **130** | 8 | 2 | **194** | C | 2 |
| **3** | 0 | 3 | **67** | 4 | 3 | **131** | 8 | 3 | **195** | C | 3 |
| **4** | 0 | 4 | **68** | 4 | 4 | **132** | 8 | 4 | **196** | C | 4 |
| **5** | 0 | 5 | **69** | 4 | 5 | **133** | 8 | 5 | **197** | C | 5 |
| **6** | 0 | 6 | **70** | 4 | 6 | **134** | 8 | 6 | **198** | C | 6 |
| **7** | 0 | 7 | **71** | 4 | 7 | **135** | 8 | 7 | **199** | C | 7 |
| **8** | 0 | 8 | **72** | 4 | 8 | **136** | 8 | 8 | **200** | C | 8 |
| **9** | 0 | 9 | **73** | 4 | 9 | **137** | 8 | 9 | **201** | C | 9 |
| **10** | 0 | A | **74** | 4 | A | **138** | 8 | A | **202** | C | A |
| **11** | 0 | B | **75** | 4 | B | **139** | 8 | B | **203** | C | B |
| **12** | 0 | C | **76** | 4 | C | **140** | 8 | C | **204** | C | C |
| **13** | 0 | D | **77** | 4 | D | **141** | 8 | D | **205** | C | D |
| **14** | 0 | E | **78** | 4 | E | **142** | 8 | E | **206** | C | E |
| **15** | 0 | F | **79** | 4 | F | **143** | 8 | F | **207** | C | F |
| **16** | 1 | 0 | **80** | 5 | 0 | **144** | 9 | 0 | **208** | D | 0 |
| **17** | 1 | 1 | **81** | 5 | 1 | **145** | 9 | 1 | **209** | D | 1 |
| **18** | 1 | 2 | **82** | 5 | 2 | **146** | 9 | 2 | **210** | D | 2 |
| **19** | 1 | 3 | **83** | 5 | 3 | **147** | 9 | 3 | **211** | D | 3 |
| **20** | 1 | 4 | **84** | 5 | 4 | **148** | 9 | 4 | **212** | D | 4 |
| **21** | 1 | 5 | **85** | 5 | 5 | **149** | 9 | 5 | **213** | D | 5 |
| **22** | 1 | 6 | **86** | 5 | 6 | **150** | 9 | 6 | **214** | D | 6 |
| **23** | 1 | 7 | **87** | 5 | 7 | **151** | 9 | 7 | **215** | D | 7 |
| **24** | 1 | 8 | **88** | 5 | 8 | **152** | 9 | 8 | **216** | D | 8 |
| **25** | 1 | 9 | **89** | 5 | 9 | **153** | 9 | 9 | **217** | D | 9 |
| **26** | 1 | A | **90** | 5 | A | **154** | 9 | A | **218** | D | A |
| **27** | 1 | B | **91** | 5 | B | **155** | 9 | B | **219** | D | B |
| **28** | 1 | C | **92** | 5 | C | **156** | 9 | C | **220** | D | C |
| **29** | 1 | D | **93** | 5 | D | **157** | 9 | D | **221** | D | D |
| **30** | 1 | E | **94** | 5 | E | **158** | 9 | E | **222** | D | E |

| Node ID | HI | LO | Node ID | HI | LO | Node ID | HI | LO | Node ID | HI | LO |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **31** | 1 | F | **95** | 5 | F | **159** | 9 | F | **223** | D | F |
| **32** | 2 | 0 | **96** | 6 | 0 | **160** | A | 0 | **224** | E | 0 |
| **33** | 2 | 1 | **97** | 6 | 1 | **161** | A | 1 | **225** | E | 1 |
| **34** | 2 | 2 | **98** | 6 | 2 | **162** | A | 2 | **226** | E | 2 |
| **35** | 2 | 3 | **99** | 6 | 3 | **163** | A | 3 | **227** | E | 3 |
| **36** | 2 | 4 | **100** | 6 | 4 | **164** | A | 4 | **228** | E | 4 |
| **37** | 2 | 5 | **101** | 6 | 5 | **165** | A | 5 | **229** | E | 5 |
| **38** | 2 | 6 | **102** | 6 | 6 | **166** | A | 6 | **230** | E | 6 |
| **39** | 2 | 7 | **103** | 6 | 7 | **167** | A | 7 | **231** | E | 7 |
| **40** | 2 | 8 | **104** | 6 | 8 | **168** | A | 8 | **232** | E | 8 |
| **41** | 2 | 9 | **105** | 6 | 9 | **169** | A | 9 | **233** | E | 9 |
| **42** | 2 | A | **106** | 6 | A | **170** | A | A | **234** | E | A |
| **43** | 2 | B | **107** | 6 | B | **171** | A | B | **235** | E | B |
| **44** | 2 | C | **108** | 6 | C | **172** | A | C | **236** | E | C |
| **45** | 2 | D | **109** | 6 | D | **173** | A | D | **237** | E | D |
| **46** | 2 | E | **110** | 6 | E | **174** | A | E | **238** | E | E |
| **47** | 2 | F | **111** | 6 | F | **175** | A | F | **239** | E | F |
| **48** | 3 | 0 | **112** | 7 | 0 | **176** | B | 0 | **240** | F | 0 |
| **49** | 3 | 1 | **113** | 7 | 1 | **177** | B | 1 | **241** | F | 1 |
| **50** | 3 | 2 | **114** | 7 | 2 | **178** | B | 2 | **242** | F | 2 |
| **51** | 3 | 3 | **115** | 7 | 3 | **179** | B | 3 | **243** | F | 3 |
| **52** | 3 | 4 | **116** | 7 | 4 | **180** | B | 4 | **244** | F | 4 |
| **53** | 3 | 5 | **117** | 7 | 5 | **181** | B | 5 | **245** | F | 5 |
| **54** | 3 | 6 | **118** | 7 | 6 | **182** | B | 6 | **246** | F | 6 |
| **55** | 3 | 7 | **119** | 7 | 7 | **183** | B | 7 | **247** | F | 7 |
| **56** | 3 | 8 | **120** | 7 | 8 | **184** | B | 8 | **248** | F | 8 |
| **57** | 3 | 9 | **121** | 7 | 9 | **185** | B | 9 | **249** | F | 9 |
| **58** | 3 | A | **122** | 7 | A | **186** | B | A | **250** | F | A |
| **59** | 3 | B | **123** | 7 | B | **187** | B | B | **251** | F | B |
| **60** | 3 | C | **124** | 7 | C | **188** | B | C | **252** | F | C |
| **61** | 3 | D | **125** | 7 | D | **189** | B | D | **253** | F | D |
| **62** | 3 | E | **126** | 7 | E | **190** | B | E | **254** | F | E |
| **63** | 3 | F | **127** | 7 | F | **191** | B | F | **255** | F | F |

**Figure 39 - Decimal node IDs and equivalent HI / LO hexadecimal switch settings**

**Note:** If the node ID selector switches are set to FF, the node's firmware will not run on power up. However, Mint WorkBench will still be able to detect the MicroFlex e100 and download new firmware.

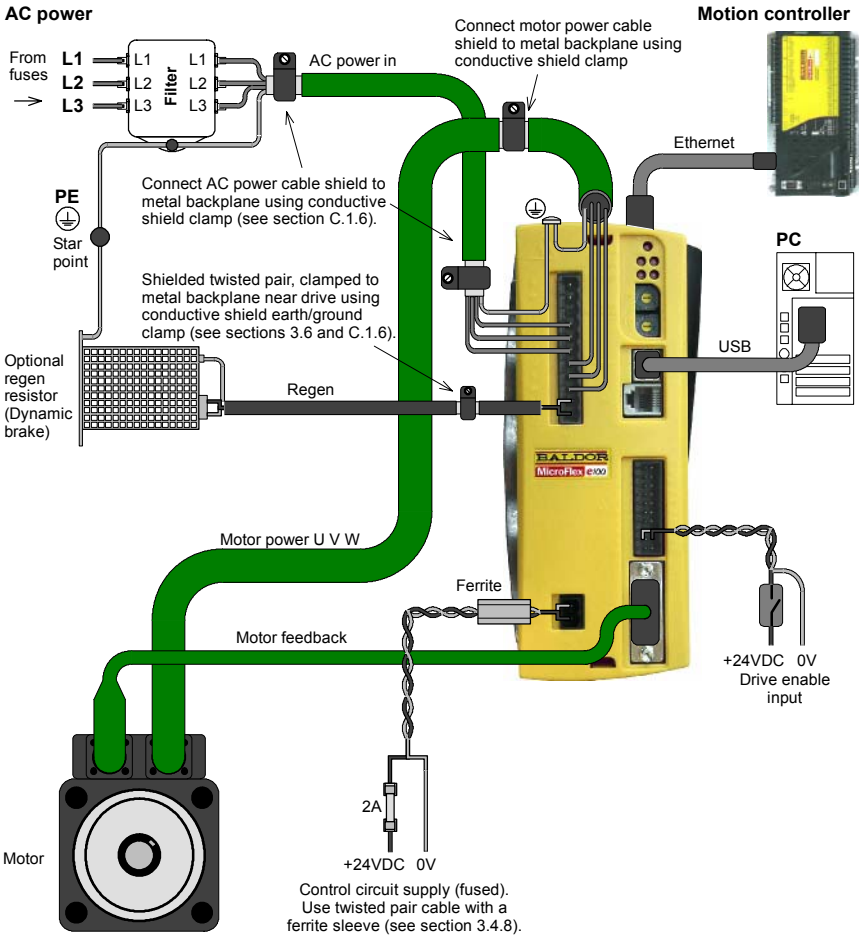
In many networking environments, the node ID may also be referred to as the *address*. On EPL networks, limitations apply to the node IDs that may be selected:

- Node ID 0 is reserved for special purposes and cannot be used.
- Setting the switches to select a node ID between 1 and 239 causes the node to become a 'controlled node', a node that will accept commands from the manager node.
- Node ID 240 is reserved for the EPL manager node (for example NextMove e100) so cannot be used by MicroFlex e100.
- Node IDs between 241 and 255 are reserved for special purposes and cannot be used.

For all other communication channels such as CANopen and USB, the node ID is set in software. Each channel can have a different node ID, selected using the Mint WorkBench Connectivity Wizard or the Mint BUSNODE keyword. See the Mint help file for details.

## 5.7 Connection summary - recommended system wiring

As an example, Figure 40 shows the recommended wiring necessary for the MicroFlex e100 to control a motor, while conforming to the EMC requirements for 'industrial' environments.




- The MicroFlex e100 should be mounted on an earthed metal backplane.
- Ensure cables do not obstruct airflow to the heatsink.
- Motor represents a typical Baldor BSM motor. Linear motors may also be controlled by MicroFlex e100.
- Conductive shield earth/ground clamps are not supplied.
- When using single phase supplies it may be necessary to reverse the AC power filter - see section 3.4.7.2.

**Figure 40 - Recommended system wiring**

# 6.1 Introduction

Before powering the MicroFlex e100 you will need to connect it to the PC using a USB or Ethernet cable and install the supplied *Mint Machine Center* software. This software includes a number of tools to allow you to configure and tune the MicroFlex e100. If you do not have experience of software installation or Windows applications you may need further assistance for this stage of the installation.

## 6.1.1 Connecting the MicroFlex e100 to the PC

The MicroFlex e100 can be connected to the PC using either USB or TCP/IP.

To use USB, connect a USB cable between a PC USB port and the MicroFlex e100 USB port. Your PC must be using Windows 2000 or Windows XP.

To use TCP/IP, connect a CAT5 Ethernet cable between the PC and one of the MicroFlex e100 Ethernet ports.

**CAUTION**: You cannot connect an ordinary office PC to the MicroFlex e100 without first altering the PC's Ethernet adapter configuration. However, if you have installed a second Ethernet adapter dedicated for use with the MicroFlex e100, then this adapter's configuration can be altered without affecting the PC's office Ethernet connection. If you are unsure about making changes to your PC's Ethernet adapter configuration, or are prevented by user permission levels, ask your I.T. administrator to assist you.

**CAUTION**: If there is a EPL manager node (node ID 240) on the Ethernet network, then the network will be operating in EPL mode. This means any TCP/IP connection from the PC must pass through an EPL compatible router.

## 6.1.2 Installing Mint Machine Center and Mint WorkBench

You will need to install Mint Machine Center (MMC) and Mint WorkBench to configure and tune the MicroFlex e100. Any previous version of Mint WorkBench must be uninstalled before proceeding with this installation:

1. Insert the CD into the drive.
2. After a few seconds the setup wizard should start automatically. If the setup wizard does not appear, select Run... from the Windows Start menu and type

   **d:\start**

   where **d** represents the drive letter of the CD device.

   Follow the on-screen instructions to install MMC (including Mint WorkBench). The setup wizard will copy the files to appropriate folders within the C:\Program Files folder, and place shortcuts on the Windows Start menu.

## 6.2 Starting the MicroFlex e100

If you have followed the instructions in the previous sections, you should now have connected all the power sources, inputs and outputs, and the Ethernet cable or USB cable linking the PC to the MicroFlex e100.

### 6.2.1 Preliminary checks

Before you apply power for the first time, it is very important to verify the following:

- Disconnect the load from the motor until instructed to apply a load. If this cannot be done, disconnect the motor wires at connector X1.
- Verify that the AC line voltage matches the specification of the MicroFlex e100.
- Inspect all power connections for accuracy, workmanship and tightness.
- Verify that all wiring conforms to applicable codes.
- Verify that the MicroFlex e100 and motor are properly earthed/grounded.
- Check all signal wiring for accuracy.

### 6.2.2 Power on checks

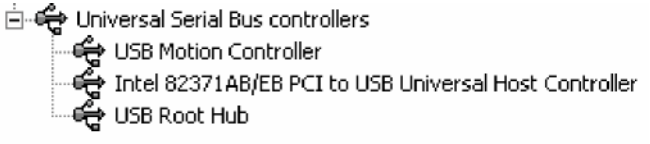
If at any time the Status LED flashes red, the drive has detected a fault - see section 7.

1. Turn on the 24VDC supply.
2. Turn on the AC supply.
3. Within approximately 20-30 seconds, the test sequence should complete and the Status LED should illuminate red. If the Status LED is not lit then re-check the power supply connections. If the Status LED flashes red, this indicates that the MicroFlex e100 has detected a fault - see section 7. Note that after downloading firmware, startup may take more than 1 minute.
4. If the motor wires were disconnected in section 6.2.1, turn off the AC supply and reconnect the motor wires. Turn on the AC supply.
5. To allow the Commissioning Wizard to function, the drive enable signal will need to be present on connector X3 to allow the MicroFlex e100 to be enabled (see section 5.2.1.). If you do not wish to enable the MicroFlex e100 yet, the Commissioning Wizard will inform you when this step is necessary.

### 6.2.3 Installing the USB driver

It is now necessary to install the USB driver. When the MicroFlex e100 is powered, Windows (2000 or XP only) will automatically detect the controller and request the driver. The driver consists of two files, *USBmotion.inf* and *USBmotion.sys*. Both files must be present for installation.

1. Follow the on-screen instructions to select and install the driver. The driver files are available on the supplied Baldor Motion Toolkit CD. If you are using a copy of the driver located on the hard disk, a floppy disk or another CD, the two driver files must be in the same folder.
2. During installation, Windows XP may report that the driver is 'unsigned'. This is normal for the MicroFlex e100 driver, so click the Continue Anyway button to continue with the installation. When installation is complete, a new USB Motion Controller device will be listed in the *Universal Serial Bus controllers* section of Windows Device Manager.




The MicroFlex e100 is now ready to be configured using Mint WorkBench.

**Note:** If the MicroFlex e100 is later connected to a different USB port on the host computer, Windows may report that it has found new hardware. Either install the driver files again for the new USB port, or connect the MicroFlex e100 to the original USB port where it will be recognized in the usual way.

### 6.2.4 Configuring the TCP/IP connection (optional)

If you have connected the MicroFlex e100 to the PC using the Ethernet connection, it will be necessary to alter the PC's Ethernet adapter configuration to operate correctly with the MicroFlex e100.

**CAUTION**: You cannot connect an ordinary office PC to the MicroFlex e100 without first altering the PC's Ethernet adapter configuration. However, if you have installed a second Ethernet adapter dedicated for use with the MicroFlex e100, then this adapter's configuration can be altered without affecting the PC's office Ethernet connection. If you are unsure about making changes to your PC's Ethernet adapter configuration, or are prevented by user permission levels, ask your I.T. administrator to assist you.

The following explanation assumes the PC is connected directly to the MicroFlex e100, and not across an intermediate Ethernet network. If you wish to attempt the connection through an intermediate Ethernet network, then the network administrator must be consulted to ensure that the necessary IP addresses will be allowed and are not already allocated on the network. The MicroFlex e100 has a fixed IP address of the format 192.168.100.*xxx*. The last number, *xxx*, is the decimal value defined by the MicroFlex e100's node ID selector switches (see section 5.6.1).

1. On the Windows Start menu, select Settings, Network Connections.
2. In the Network Connections Window, right-click the 'Local Area Connection' entry for the required Ethernet adapter and choose Properties.
3. In the Local Area Connection Properties dialog, in the 'This connection uses the following items' list, select the 'Internet Protocol (TCP/IP)' entry and click **Properties**.
4. In the Internet Protocol (TCP/IP) Properties dialog, on the General tab, make a note of the existing settings. Click **Advanced...** and make a note of any existing settings. Click the Alternate Configuration tab and make a note of any existing settings.
5. On the General tab, choose the 'Use the following IP address' option.
6. In the IP address box, enter the IP address 192.168.100.241. This is the IP address that will be assigned to the Ethernet adapter. The value 241 is deliberately chosen as it is outside the range that can be used by MicroFlex e100, so avoiding possible conflicts.

7. In the Subnet mask box, enter 255.255.255.0 and click **OK**.
   Click **OK** to close the Local Area Connection Properties dialog.
8. On the Windows Start menu, select Command Prompt (often found under Accessories).
9. In the Command Prompt window, type PING 192.168.100.16, where the final value (16 in this example) is the value selected by the MicroFlex e100's node ID selector switches. In this example, the MicroFlex e100's switches would be set to HI=1 LO=0, which represents hexadecimal 10, equivalent to decimal 16 (see section 5.6.1 for a list of hexadecimal / decimal equivalents). A reply message should be returned.
10. It should now be possible to run Mint WorkBench and connect to the MicroFlex e100 using the Ethernet / TCP/IP connection.

## 6.3 Mint Machine Center

The Mint Machine Center (MMC) is used to view the network of connected controllers in a system. Individual controllers and drives are configured using Mint WorkBench.

**Note:** If you have only a single MicroFlex e100 connected to your PC, then MMC is probably not required. Use Mint WorkBench (see section 6.4) to configure the MicroFlex e100.

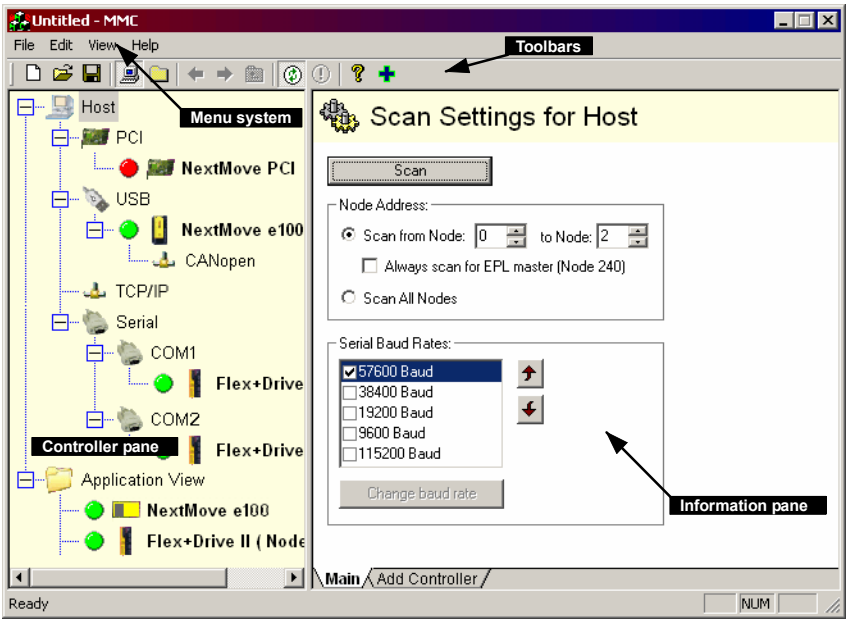



**Figure 41 - The Mint Machine Center software**

The Mint Machine Center (MMC) provides an overview of the controller network currently accessible by the PC. The MMC contains a controller pane on the left, and an information pane on the right. In the controller pane select the Host item, then in the information pane click **Scan**. This causes MMC to scan for all connected controllers. Clicking once on a controller's name causes various options to be displayed in the information pane. Double-clicking on a controller's name launches an instance of Mint WorkBench that is automatically connected to the controller.

Application View allows the layout and organization of controllers in your machine to be modelled and described on screen. Controllers can be dragged onto the Application View icon, and renamed to give a more meaningful description, for example "Conveyor 1, Packaging Controller". Drives that are controlled by another product, such as a NextMove e100, can be dragged onto the NextMove e100 icon itself, creating a visible representation of the machine. A text description for the system and associated files can be added, and the resulting layout saved as an "MMC Workspace". When you next need to administer the system, simply loading the workspace automatically connects to all the required controllers. See the Mint help file for full details of MMC.

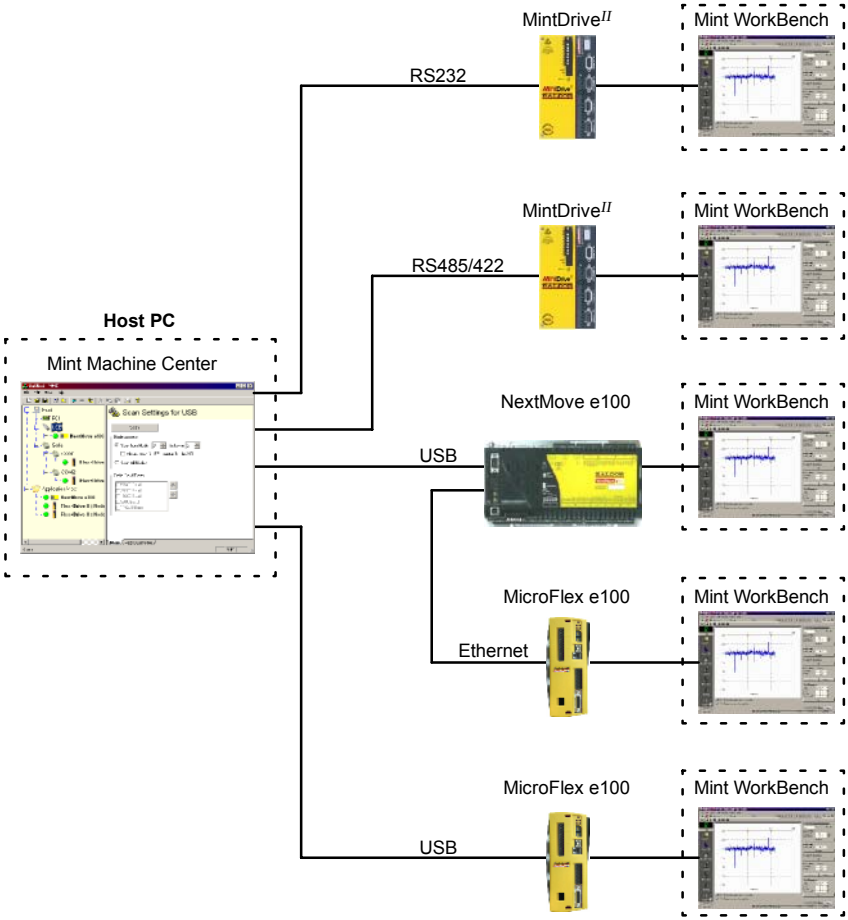
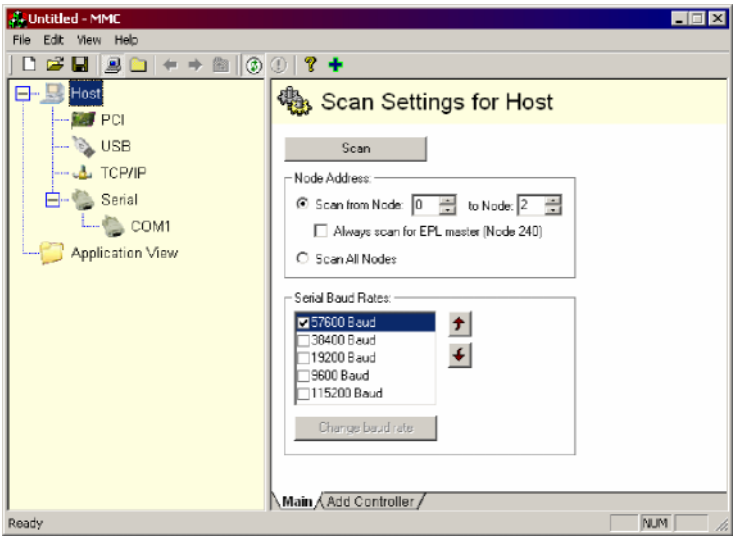



**Figure 42 - Typical network visibility provided by Mint Machine Center**

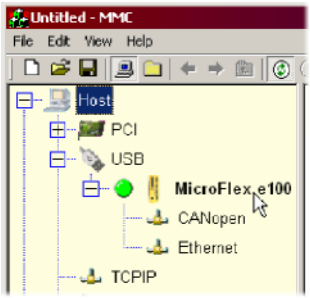
### 6.3.1 Starting MMC

1. On the Windows **Start** menu, select Programs, Mint Machine Center, Mint Machine Center.




2. In the controller pane, ensure that Host is selected. In the information pane, click **Scan.**


3. When the search is complete, click once on 'MicroFlex e100' in the controller pane to select it, then double click to open an instance of Mint WorkBench. The MicroFlex e100 will be already connected to the instance of Mint WorkBench, ready to configure.



## 6.4 Mint WorkBench

Mint WorkBench is a fully featured application for commissioning the MicroFlex e100. The main Mint WorkBench window contains a menu system, the Toolbox and other toolbars. Many functions can be accessed from the menu or by clicking a button - use whichever you prefer. Most buttons include a 'tool-tip'; hold the mouse pointer over the button (don't click) and its description will appear.

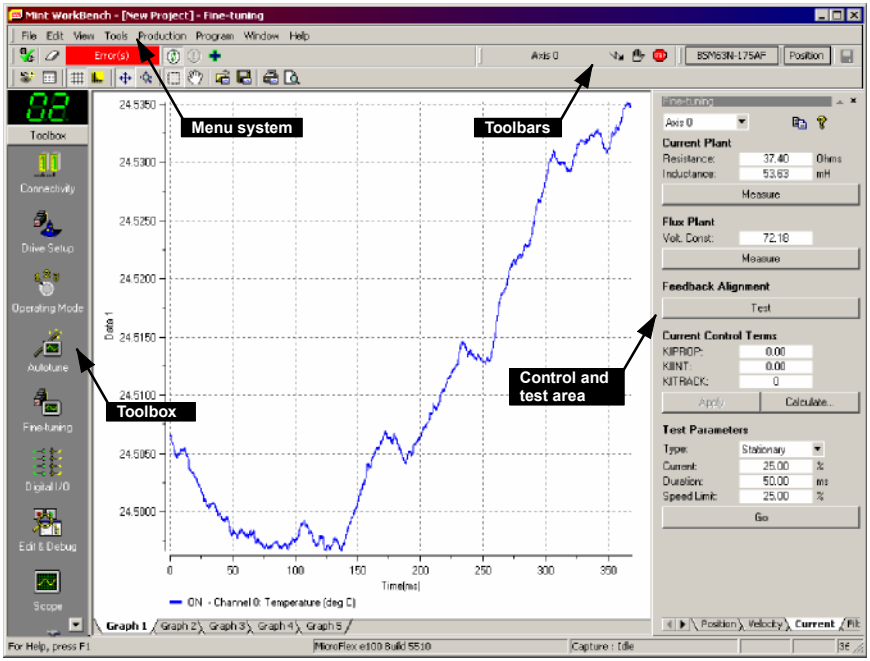



**Figure 43 - The Mint WorkBench software**

### 6.4.1 Help file

Mint WorkBench includes a comprehensive help file that contains information about every Mint keyword, how to use Mint WorkBench and background information on motion control topics. The help file can be displayed at any time by pressing F1. On the left of the help window, the Contents tab shows the tree structure of the help file. Each book contains a number of topics. The Index tab provides an alphabetic list of all topics in the file, and allows you to search for them by name. The Search tab allows you to search for words or phrases appearing anywhere in the help file. Many words and phrases are underlined and highlighted with a color (normally blue) to show that they are links. Just click on the link to go to an associated keyword. Most keyword topics begin with a list of relevant *See Also* links.

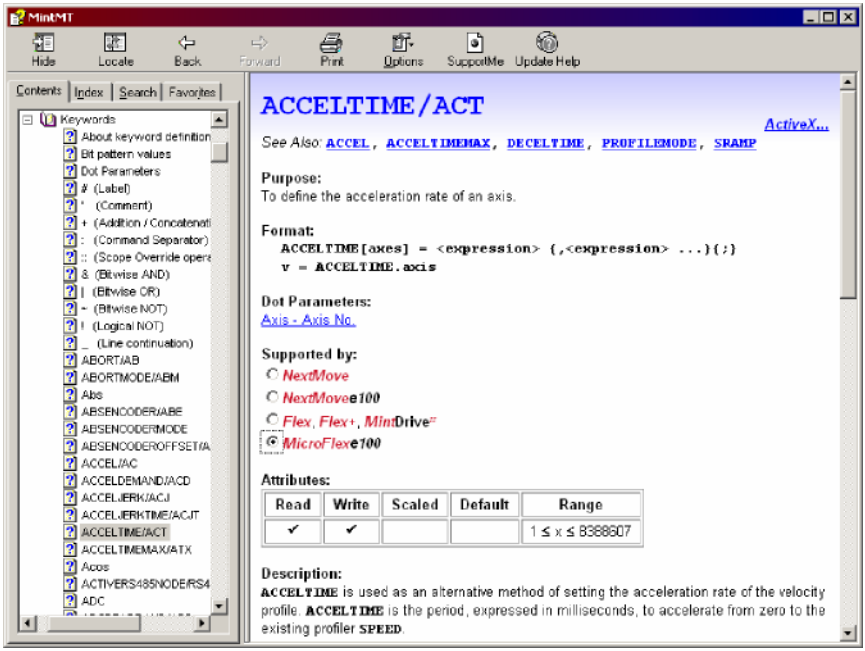


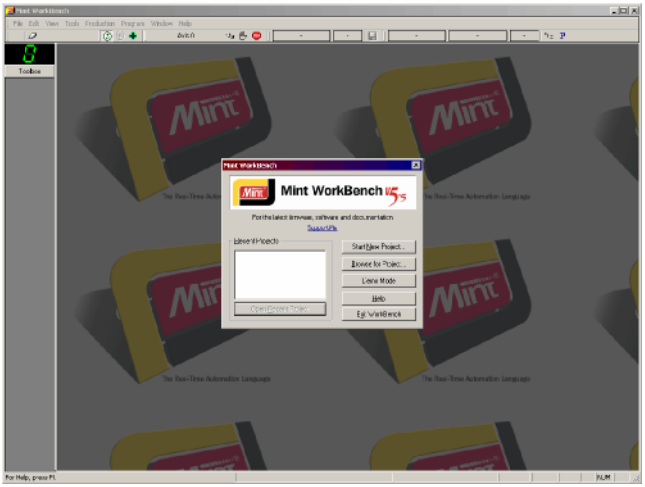

**Figure 44 - The Mint WorkBench help file**

For help on using Mint WorkBench, click the **Contents** tab, then click the small plus sign ⊞ beside the **Mint WorkBench** book icon. Double click a topic name to display it.

## 6.4.2 Starting Mint WorkBench

**Note:** If you have already used MMC to start an instance of Mint WorkBench then the following steps are unnecessary. Go to section 6.4.3 to continue configuration.

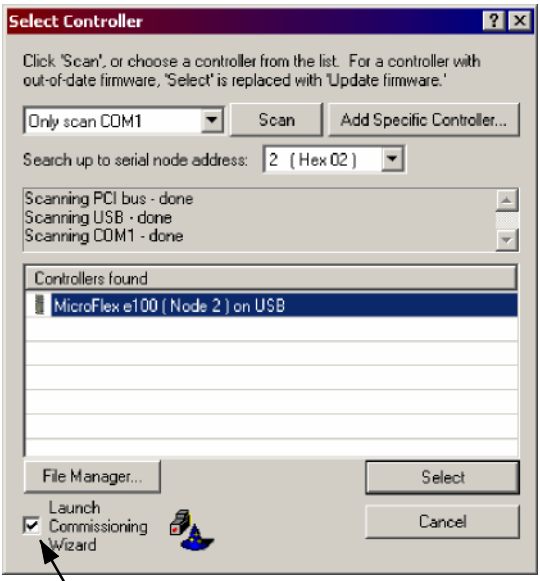
1. On the Windows **Start** menu, select Programs, Mint Machine Center, WorkBench v5.5.




2. In the opening dialog box, click **Start New Project...** .

3. In the Select Controller dialog, click **Scan** to search for the MicroFlex e100. Mint WorkBench will scan the PC's ports for the MicroFlex e100.

   When the search is complete, click 'MicroFlex e100' in the list to select it, then click **Select**.

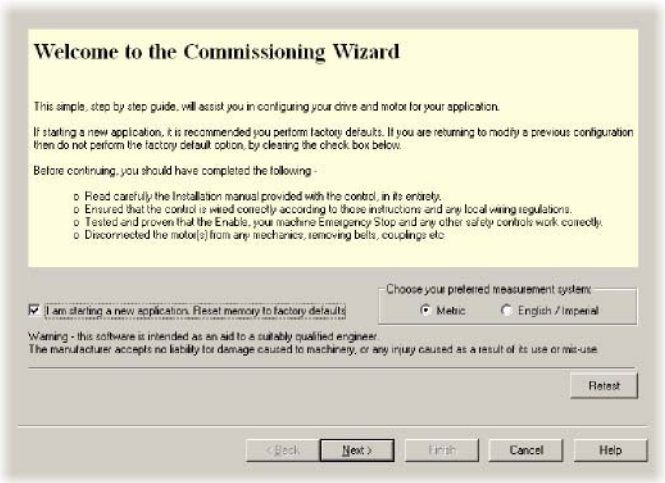



**Note:** If the MicroFlex e100 is not listed, check the USB or Ethernet cable between the MicroFlex e100 and the PC. Check that the MicroFlex e100 is powered correctly. Click **Scan** to re-scan the ports.

### 6.4.3 Commissioning Wizard

Each type of motor and drive combination has different performance characteristics. Before the MicroFlex e100 can be used to control the motor accurately, the MicroFlex e100 must be 'tuned'. This is the process where the MicroFlex e100 powers the motor in a series of tests. By monitoring the feedback from the motor's encoder and performing a number of calculations, the MicroFlex e100 can make small adjustments to the way it controls the motor. This information is stored in the MicroFlex e100 and can be uploaded to a file if necessary.

The Commissioning Wizard provides a simple way to tune the MicroFlex e100 and create the necessary configuration information for your drive/motor combination, so this is the first tool that should be used. If necessary, any of the parameters set by the Commissioning Wizard can be adjusted manually after commissioning is complete.




### 6.4.3.1 Using the Commissioning Wizard

**CAUTION**: The motor will move during commissioning. For safety it is advisable to disconnect any load from the motor during initial commissioning. The motor can be tuned with the load connected after the Commissioning Wizard has finished.

Each screen of the Commissioning Wizard requires you to enter information about the motor or drive. Read each screen carefully and enter the required information.

On the Operating Mode screen, it is important to select 'Host/Mint' as the Reference Source. This will allow the Autotune Wizard to operate correctly, and allow further initial testing to be performed using Mint WorkBench. Although the MicroFlex e100 may eventually be controlled over ETHERNET Powerlink (EPL), this reference source should only be selected after the MicroFlex e100 has been commissioned and is ready to add to the EPL network. This can be selected by choosing the Operating Mode tool in the Toolbox.

If you need extra help, click **Help** or press F1 to display the help file.

When you have completed a screen, click **Next >** to display the next screen. If you need to change something on a previous screen, click the **< Back** button. The Commissioning Wizard remembers information that you have entered so you will not need to re-enter everything if you go back to previous screens.

During commissioning, changed parameters are stored in the MicroFlex e100's temporary (volatile) memory. For this reason, the Commissioning Wizard will occasionally prompt you to save the parameters. Selecting **Yes** will cause the parameters to be saved in the MicroFlex e100's non-volatile flash memory, to be retained when power is removed. If you select **No**, you must remember to use the *Save Drive Parameters* function before removing power from the MicroFlex e100; this function is available on the Tools menu, or by clicking the button on the Mode toolbar. Saving parameters into flash memory will cause the MicroFlex e100 to be reset.

### 6.4.4 Performing a test move

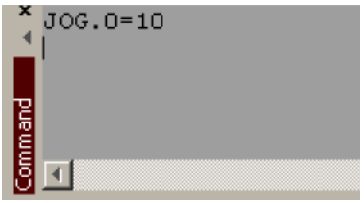
This section tests the basic operation of the drive and motor.

1. Check that the Drive enable button is pressed (down).


2. In the Toolbox, click the Edit & Debug icon.


3. Click in the Command window.

4. Type:
   `JOG.0 = 10`




   This will cause the motor to move continuously at 10 units per second. In Mint WorkBench, look at the Spy window located on the right of the screen. The Spy window's Velocity display should show 10 (approximately). If there seems to be very little motor movement, it is probably due to the scale factor. In the Commissioning Wizard, on the Select Scale Factor page, if you did *not* adjust the scale factor then the current unit of movement is feedback counts per second. Depending on the motor's feedback device, 10 feedback counts per second could equate to a very small velocity. Issue another `JOG` command using a larger value, or use the Operating Mode Wizard to select a suitable scale factor (e.g. 4000 if the motor has a 1000 line encoder, or 10,000 for a 2500 line encoder).

5. To stop the test, type:
   `STOP.0`

## 6.5 Further configuration

Mint WorkBench provides a number of tools, each of which has an icon on the left of the screen. Click once on an icon to select the tool. Two of the main tools used for tuning and configuring the MicroFlex e100 are described in the following sections. Every tool is explained fully in the help file. Press F1 to display the help file, then navigate to the Mint WorkBench book. Inside this is the Toolbox book.

### 6.5.1 Fine-tuning tool

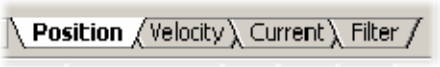
The Commissioning Wizard calculates many parameters that allow the MicroFlex e100 to provide basic control of the motor. These parameters may need to be fine-tuned to provide the exact response that you require. The Fine-tuning screen allows you to do this.

1. Click the Fine-tuning icon in the Toolbox on the left of the screen.


   The Fine-tuning window is displayed at the right of the screen. This already shows some of the parameters that have been calculated by the Commissioning Wizard.

   The main area of the Mint WorkBench window displays the capture window. When further tuning tests are performed, this will display a graph representing the response.

2. The Fine-tuning window has four tabs at the bottom - Position, Velocity, Current and Filter. Click on a tab to select it.




   Click the tab for the type of tests you wish to perform.

   **Note:** Some tabs may not be available depending on the configuration mode you selected in the Commissioning Wizard.

#### 6.5.1.1 Fine-tuning - Position tab

The Position tab allows you to adjust position loop settings and perform test moves. The Commissioning Wizard may have already set some of these values, depending on the type of system selected on the mode screen.

Enter new values in the required boxes and then click **Apply** to download the values to the MicroFlex e100. To perform tests, go to the Test Parameters area at the bottom of the tab. Enter test values and then click **Go** to perform the test move. If you need help, just press F1 to display the help file.

#### 6.5.1.2 Fine-tuning - Velocity tab

The Velocity tab allows you to set velocity loop gains and perform test moves. The Commissioning Wizard may have already set some of these values, depending on the type of system selected on the mode screen.

Enter new values in the required boxes and then click **Apply** to download the values to the MicroFlex e100. To perform tests, go to the Test Parameters area at the bottom of the tab. Enter test values and then click **Go** to perform the test move. If you need help, just press F1 to display the help file.

#### 6.5.1.3 Fine-tuning - Current tab

The Current tab allows you to set current loop gains and perform test moves. The Commissioning Wizard may have already set some of these values, depending on the type of system selected on the mode screen. Normally, it should not be necessary to alter these values.

Enter new values in the required boxes and then click **Apply** to download the values to the MicroFlex e100. To perform tests, go to the Test Parameters area at the bottom of the tab. Enter test values and then click **Go** to perform the test move. If you need help, just press F1 to display the help file.

The additional **Measure** and **Feedback alignment** buttons can be used to repeat the same measurement and alignment tests that are used by the Commissioning Wizard.

#### 6.5.1.4 Fine-tuning - Filter tab

The Filter tab allows you to set the properties of the MicroFlex e100's two torque filters. It should only be necessary to use the torque filters if there is a particular problem with resonant frequencies in the load.

Enter new values in the required boxes and then click **Apply** to download the values to the MicroFlex e100. To perform tests, go to the Frequency Response Params area at the bottom of the tab. Enter test values and then click **Go** to perform the test move. If you need help, just press F1 to display the help file.

## 6.5.2 Parameters tool

The Parameters tool can be used to view or change most of the drive's parameters.

1. Click the Parameters icon in the Toolbox on the left of the screen.

   The main area of the Mint WorkBench window displays the Parameters editor screen.


2. In the parameters tree, scroll to the required item. Click on the small + sign beside the item's name.


3. The adjacent table will list the parameters for the chosen item.

   Scroll to the required entry.

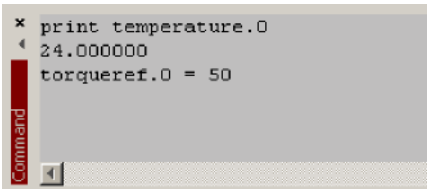
   Click in the Active Table cell and enter a value. This immediately sets the parameter, which will remain in the MicroFlex e100 until another value is defined. The icon to the left of the item will change from green to yellow to indicate that the value has been changed.


   Many of the MicroFlex e100's parameters are set automatically by the Commissioning Wizard, or when tests are performed in the fine-tuning window.

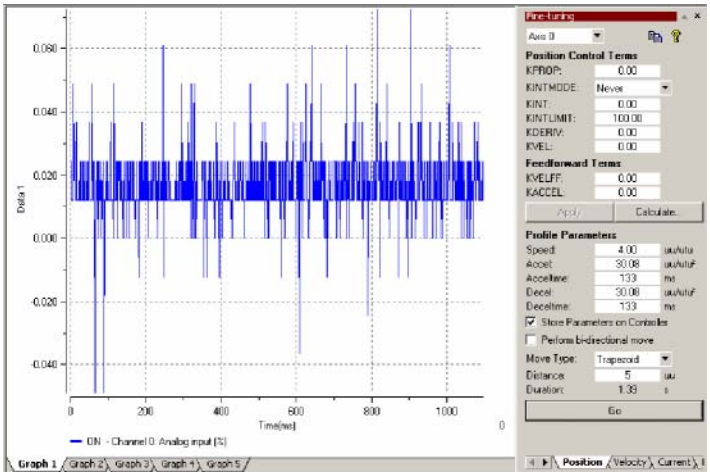
### 6.5.3 Other tools and windows

Each tool and window is explained fully in the help file, so is not described here in detail.

- Edit & Debug Tool
  This tool provides a work area including the Command window and Output window. The Command window can be used to send immediate Mint commands to the MicroFlex e100. If you tried the test move in section 6.4.4, then you have already used Edit & Debug mode.

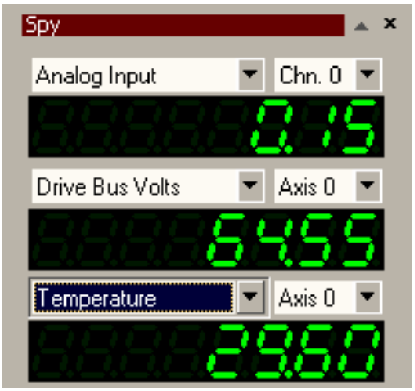



- Scope Tool
  Displays the capture screen. This screen is also shown when the Fine-tuning tool is selected.




- Spy window
  Allows you to monitor all the important parameters for the axis.

  Remember, for help on each tool just press F1 to display the help file, then navigate to the Mint WorkBench book. Inside this is the Toolbox book.



# 7.1 Introduction

This section explains common problems that may be encountered, together with possible solutions. If you want to know the meaning of the LED indicators, see section 7.2.

## 7.1.1 Problem diagnosis

If you have followed all the instructions in this manual in sequence, you should have few problems installing the MicroFlex e100. If you do have a problem, read this section first.
In Mint WorkBench, use the Error Log tool to view recent errors and then check the help file.
If you cannot solve the problem or the problem persists, the SupportMe feature can be used.

## 7.1.2 SupportMe feature

The SupportMe feature is available from the Help menu or by clicking the  button on the motion toolbar. SupportMe can be used to gather information which can then be e-mailed, saved as a text file, or copied to another application. The PC must have e-mail facilities to use the e-mail feature. If you prefer to contact Baldor technical support by telephone or fax, contact details are provided at the front of this manual. Please have the following information ready:

- The serial number of your MicroFlex e100 (if known).
- Use the Help, SupportMe menu item in Mint WorkBench to view details about your system.
- The catalog and specification numbers of the motor that you are using.
- A clear description of what you are trying to do, for example trying to establish communications with Mint WorkBench or trying to perform fine-tuning.
- A clear description of the symptoms that you can observe, for example the Status LED, error messages displayed in Mint WorkBench, or errors reported by the Mint error keywords ERRORREADCODE or ERRORREADNEXT.
- The type of motion generated in the motor shaft.
- Give a list of any parameters that you have setup, for example the motor data you entered/selected in the Commissioning Wizard, the gain settings generated during the tuning process and any gain settings you have entered yourself.

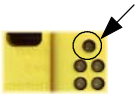
## 7.1.3 Power-cycling the MicroFlex e100

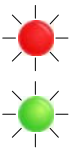
The term “Power-cycle the MicroFlex e100” is used in the Troubleshooting sections. Remove the 24V supply, wait for the MicroFlex e100 to power down completely (the Status LED will turn off), then re-apply the 24V supply.

# 7.2 MicroFlex e100 indicators

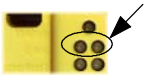
## 7.2.1 STATUS LED

The Status LED indicates general MicroFlex e100 status information.



| | |
|---|---|
|  | Solid green:<br>Drive enabled (normal operation). |
|  | Flickering / blinking green:<br>Firmware download / update in progress. |
|  | Solid red:<br>Drive disabled, but no errors are latched. |
|  | Flashing red:<br>Powerbase fault or error(s) present. The number of flashes indicates which error has occurred. For example, to display error 3 (overcurrent trip), the LED flashes 3 times at 0.1 second intervals, followed by a 0.5 second pause. The sequence is repeated continuously.<br><br>Error code (no. of flashes) — Meaning<br><br>1 . . . . . DC bus overvoltage trip.<br>2 . . . . . IPM (integrated power module) trip.<br>3 . . . . . Overcurrent trip.<br>4 . . . . . Overspeed trip.<br>5 . . . . . Feedback trip.<br>6 . . . . . Motor overload ($I^2t$) trip.<br>7 . . . . . Overtemperature trip.<br>8 . . . . . Drive overload (It) trip.<br>9 . . . . . Following error trip.<br>10 . . . . . Error input triggered.<br>11 . . . . . Phase search error.<br>12 . . . . . All other errors, including: Internal supply error, encoder supply error, parameter restore failure, power base not recognized.<br><br>If multiple errors occur at the same time, the lowest numbered error code will be flashed. For example, a MicroFlex e100 which has tripped on both feedback error (code 5) and over-current error (code 3) will flash error code 3. If the drive is already displaying an error code when a new error with a lower code occurs, the drive will start flashing the new code. Note that undervoltage trip does not appear in the table because it is already indicated by the green/red flashing state. If an undervoltage trip occurs in conjunction with another error, the drive will flash the code of the additional error.<br>Further details about error codes can be found in the Mint WorkBench help file. Press F1 and locate the *Error Handling* book. |
|  | Alternate red/green flashing:<br>Undervoltage warning (no AC power), but no errors are latched.<br><br>The DC-bus voltage has dropped below the powerbase undervoltage level (see `DRIVEBUSUNDERVOLTS`). This error will only be generated if the drive is in the enabled state. Check the AC power is connected. |

## 7.2.2 CAN LEDs



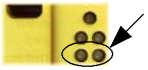
The CAN LEDs display the overall condition of the CANopen interface, once the startup sequence has completed. The LED codes conform to the CAN in Automation (CiA) DR303_3 indicator standard. The green LED indicates the state of the node's internal CANopen 'state machine'. The red LED indicates the state of the physical CANopen bus.

| **Green (run)** | |
|---|---|
|  | Off: Node initializing or not powered. |
|  | 1 flash: Node in STOPPED state.<br>3 flashes: Software is being downloaded to the node.<br>Continuous flashing: Node in PRE-OPERATIONAL state.<br>Flickering (very fast flashing): Auto-baudrate detection or LSS services in progress; flickers alternately with red LED. |
|  | Continuously illuminated, not flashing: Node in OPERATIONAL state. |

| **Red (error)** | |
|---|---|
|  | Off: No errors or not powered. |
|  | 1 flash: Warning - too many error frames.<br>2 flashes: Guard event or heartbeat event has occurred.<br>3 flashes: The SYNC message has not been received within the timeout period.<br>Flickering (very fast flashing): Auto-baudrate detection or LSS services in progress; flickers alternately with green LED. |
|  | Continuously illuminated, not flashing: The node's CAN controller is in the BUS OFF state, preventing it from taking part in any CANopen communication. |

### 7.2.3 ETHERNET LEDs

The ETHERNET LEDs display the overall condition of the Ethernet interface once the startup sequence has completed. The LED codes conform to the ETHERNET Powerlink Standardization Group (EPSG) standard at the time of production.



| Green (status) | |
|---|---|
|  | Off: Node in NOT ACTIVE state. The controlled node is waiting to be triggered by the manager node. |
|  | 1 flash: Node in PRE-OPERATIONAL1 state. EPL mode is starting.<br><br>2 flashes: Node in PRE-OPERATIONAL2 state. EPL mode is starting.<br><br>3 flashes: Node in READY TO OPERATE state. The node is signalling its readiness to operate.<br><br>Blinking (continuous flashing): Node in STOPPED state. The controlled node has been deactivated.<br><br>Flickering (very fast flashing): Node in BASIC ETHERNET state (EPL is not operating, but other Ethernet protocols may be used). |
|  | Continuously illuminated, not flashing: Node in OPERATIONAL state. EPL is operating normally. |

| Red (error) | |
|---|---|
|  | Off: EPL is working correctly. |
|  | Continuously illuminated: An error has occurred. |

### 7.2.4 Communication

**Status LED is off:**

- Check that the 24VDC control circuit supply is connected correctly to connector X2 and is switched on.

**ETHERNET LEDs blinking green and red simultaneously:**

- Does the MicroFlex e100 have firmware in it? If you tried to download new firmware and the download failed, the controller may not have firmware. Download new firmware.

**Mint WorkBench fails to detect the MicroFlex e100:**

- Ensure that the MicroFlex e100 is powered and the Status LED is illuminated (see section 7.2.1).
- Check that the Ethernet or USB cable is connected between the PC and MicroFlex e100.
- Try an alternative cable or different port on the PC.
- In the "Search up to Node*xx*" option in Mint WorkBench's Select Controller dialog, check that the MicroFlex e100's node ID is not higher than the selected value, or search up to a greater node ID.
- For USB connections, check that the cable is properly connected. Check the USB connector socket pins for damage or sticking. Check that the USB device driver has been installed; a 'USB Motion Controller' device should be listed in Windows Device Manager.
- Check that the PC's Ethernet port has been correctly configured for TCP/IP operation (see section 6.2.4).

### 7.2.5 Power on

**The Status LED is flashing red:**

- The MicroFlex e100 has detected a motion error. Click the Error button on the motion toolbar to view a description of the error. Alternatively, select the Error Log tool to view a list of errors.

  Click the **Clear Errors** button on the motion toolbar.

### 7.2.6 Mint WorkBench

**The Spy window does not update:**

- The system refresh has been disabled. Go to the Tools, Options menu item, select the System tab and then choose a System Refresh Rate (500ms is recommended).

**Cannot communicate with the controller after downloading firmware:**

- After firmware download, always power cycle the MicroFlex e100 (remove 24V power and then reconnect).

**Mint WorkBench loses contact with MicroFlex e100 while connected using USB:**

- Check that the MicroFlex e100 is powered.
- Check that a 'USB Motion Controller' device is listed in Windows Device Manager. If not, there could be a problem with the PC's USB interface.

### 7.2.7 Tuning

**Cannot enable the MicroFlex e100 because there is an error 10010:**

- Check the drive enable input on connector X3 pins 9 and 19 is connected and powered correctly.

**When the MicroFlex is enabled the motor is unstable:**

- Check that the load is firmly coupled to the motor.
- Use the Mint WorkBench Drive Setup Wizard to confirm that the correct motor data has been entered.
- Use the Mint WorkBench Autotune Wizard to retune the motor.
- If the motor is still unstable, select the Mint WorkBench Autotune Wizard once more. Click **Options...**. On the Bandwidth tab, move the Current and/or Position and Speed Control sliders to a slower position to select to a lower bandwidth. Click **OK** to exit and then start the Autotune Wizard again.

### 7.2.8 Ethernet

**Cannot connect to the drive over TCP/IP:**

- Check that there is not an EPL manager node (for example NextMove e100 with node ID 240) on the network. If there is a manager node on the network, then an EPL compatible router must be used to allow TCP/IP communication on the EPL network.
- Check that the PC's Ethernet adapter has been correctly configured, as described in section 6.2.4.

**The ETHERNET Powerlink network does not seem to be operating correctly:**

- Confirm that only one device on the newtork is set to be the ETHERNET Powerlink manager node (node ID 240, selector switches LO = F, HI = 0).
- Confirm that the reference source on all controlled nodes has been set to EPL in the Mint WorkBench Operating Mode Wizard, and that the manager node has been configured correctly. For a NextMove e100 manager node, this requires the System Config Wizard to be used in Mint WorkBench.
- Confirm that each device on the network has a different node ID.
- Confirm that there are no more than 10 'daisy-chained' devices on each branch of the network.

### 7.2.9 CANopen

**The CANopen bus is 'passive':**

This means that the internal CAN controller in the MicroFlex e100 is experiencing a number of Tx and/or Rx errors, greater than the passive threshold of 127. Check:

- 12-24V is being applied between pin 9 (+24V) and pin 6 or 3 (0V) of the CAN connector, to power the opto-isolators.
- There is at least one other CANopen node in the network.
- The network is terminated *only* at the ends, not at intermediate nodes.
- All nodes on the network are running at the same baud rate.
- All nodes have been assigned a unique node ID.

- The integrity of the CAN cables.

The MicroFlex e100 should recover from the 'passive' state once the problem has been rectified (this may take several seconds).

**The CANopen bus is 'off':**

This means that the internal CAN controller in the MicroFlex e100 has experienced a fatal number of Tx and/or Rx errors, greater than the off threshold of 255. At this point the node will have switched itself to a state whereby it cannot influence the bus. Check:

- 12-24V is being applied between pin 9 (+24V) and pin 6 or 3 (0V) of the CAN connector, to power the opto-isolators.
- There is at least one other CANopen node in the network.
- The network is terminated *only* at the ends, not at intermediate nodes.
- All nodes on the network are running at the same baud rate.
- All nodes have been assigned a unique node ID.
- The integrity of the CAN cables.

To recover from the 'off' state, the source of the errors must be removed and bus then reset. This can be done using the Mint `BUSRESET` keyword, or by resetting the MicroFlex e100.

**The Manager node cannot scan/recognize a node on the network using the Mint `NODESCAN` keyword:**

Assuming that the network is working correctly (see previous symptoms) and the bus is in an 'Operational' state, check:

- Only nodes that conform to DS401, DS403 and other Baldor CANopen nodes are recognized by the Mint `NODESCAN` keyword. Other types of node will be identified with a type "unknown" (255) when using the Mint `NODETYPE` keyword.
- Check that the node in question has been assigned a unique node ID.
- The node must support the node guarding process. MicroFlex e100 does not support the Heartbeat process.
- Try power-cycling the node in question.

If the node in question does not conform to DS401 or DS403 and is not a Baldor CANopen node, communication is still possible using a set of general purpose Mint keywords. See the Mint help file for further details.

**The node has been successfully scanned / recognized by the Manager node, but communication is still not possible:**

For communication to be allowed, a connection must be made to a node after it has been scanned:

- Baldor controller nodes are automatically connected to after being scanned.
- Nodes that conform to DS401, DS403 must have the connections made manually using the Mint `CONNECT` keyword.

If a connection attempt using `CONNECT` fails then it may be because the node being connected to does not support an object which needs to be accessed in order to setup the connection.

# 8.1 Introduction

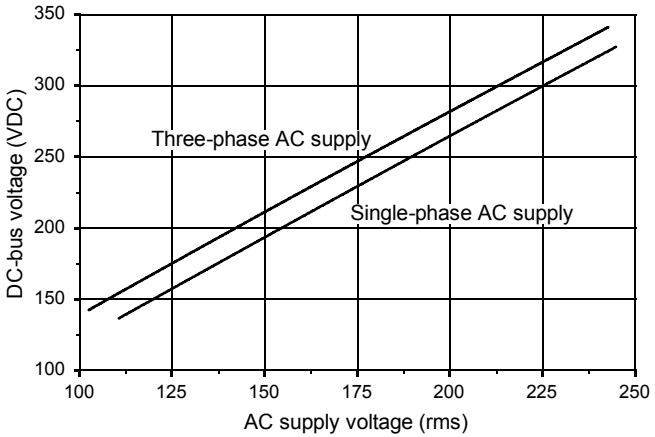
This section provides technical specifications for the MicroFlex e100.

## 8.1.1 AC input power and DC bus voltage (X1)

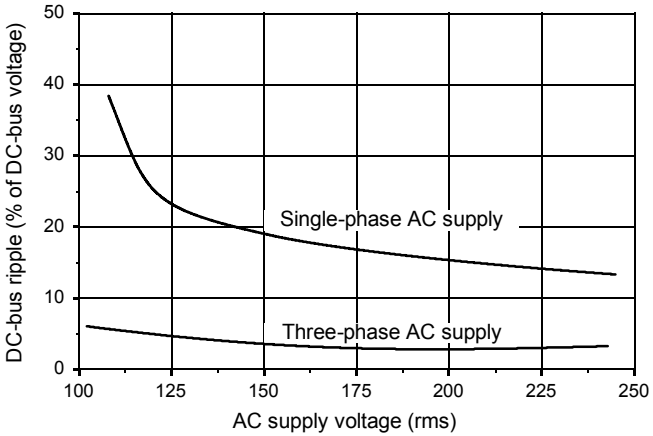
| ***All models*** | **Unit** | **AC input** | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1Φ** | | | **3Φ** | | |
| **Nominal input voltage** | **VAC** | 115 or 230 | | | | | |
| Minimum input voltage | | 105* | | | | | |
| Maximum input voltage | | 250 | | | | | |
| **Nominal DC-bus voltage** @230VAC input | **VDC** | 305 | | | 321 | | |
| | | **3A** | **6A** | **9A** | **3A** | **6A** | **9A** |
| **Nominal input current** @ maximum rated output current | **A** | 7.5 | 15 | 22 | 4 | 8 | 12 |

* The MicroFlex e100 will operate at lower input voltages, although the drive will trip if the DC-bus voltage falls below 50V or 60% of the no-load voltage, whichever occurs first.

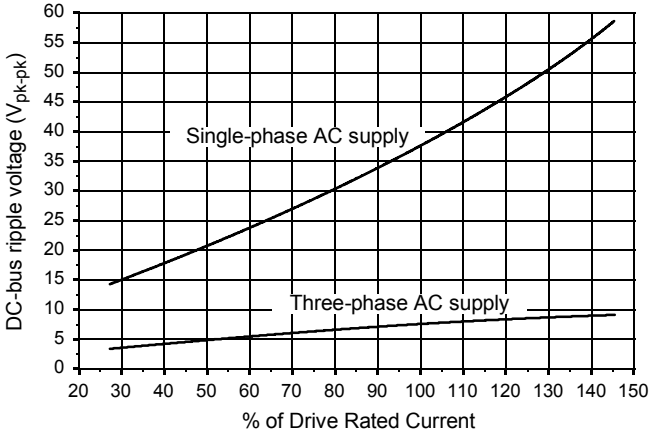
### 8.1.1.1 Effect of AC power supply voltage on DC-bus voltage



#### 8.1.1.2 Effect of AC power supply voltage on DC-bus ripple




#### 8.1.1.3 Effect of output current on DC-bus ripple voltage



### 8.1.2 24VDC control circuit supply input (X2)

| | Unit | 3A | 6A | 9A |
|---|---|---|---|---|
| **Nominal input voltage** | **VDC** | 24 | | |
| Minimum input voltage | | 20 | | |
| Maximum input voltage | | 30 | | |
| **Maximum ripple** | **%** | ±10 | | |
| **Maximum continuous current @24VDC** | **A** | 0.6 | | |
| **Power on surge current (typical)** @24VDC, 100ms | **A** | 4 | | |

### 8.1.3 Motor output power (X1)

| | Unit | 3A | 6A | 9A |
|---|---|---|---|---|
| **Nominal phase current** | **$A_{RMS}$** | 3 | 6 | 9 |
| **Peak phase current** for 3s | **$A_{RMS}$** | 6 | 12 | 18 |
| **Nominal output** @ 230V, 3Φ | **VA** | 1195 | 2390 | 3585 |
| **Output voltage range (line-line)** @VDC-bus=320V | **$V_{RMS}$** | 0 - 230 | | |
| **Output frequency** | **Hz** | 0 - 2000 | | |
| **Output dV/dt**<br>at drive, phase-phase<br>at drive, phase-ground<br>at motor (using 20m cable), phase-phase<br>at motor (using 20m cable), phase-ground | **kV/µs** | <br>2<br>1.1<br>1.9<br>1.8 | | |
| **Nominal switching frequency** | **kHz** | 8.0 | | |
| **Minimum motor inductance** (per winding) | **mH** | 1 | | |
| **Efficiency** | **%** | >95 | | |

### 8.1.4 Regeneration (X1)

| | Unit | 3A | 6A | 9A |
|---|---|---|---|---|
| **Nominal switching threshold (typical)** | **VDC** | on: 388, off: 376 | | |
| **Nominal power** (10% power cycle, R=57Ω) | **kW** | 0.25 | | |
| **Peak power** (10% power cycle, R=57Ω) | **kW** | 2.7 | | |
| **Maximum regeneration switching current** | **$A_{PK}$** | 10 | | |
| **Minimum load resistance** | **Ω** | 39 | | |
| **Maximum load inductance** | **µH** | 100 | | |

### 8.1.5 Digital inputs - drive enable and DIN0 general purpose (X3)

| | Unit | All models |
|---|---|---|
| **Type** | | Opto-isolated inputs |
| **Input voltage**<br>Nominal<br>Minimum<br>Maximum | **VDC** | <br>24<br>12<br>30 |
| **Input current** (maximum, per input) | **mA** | 50 |
| **Sampling interval** | **ms** | 1 |
| **Minimum pulse width** | **µs** | 5 |

### 8.1.6 Digital inputs DIN1, DIN2 - high speed general purpose (X3)

| | Unit | All models |
|---|---|---|
| **Type** | | Opto-isolated inputs |
| **Input voltage**<br>Nominal<br>Minimum<br>Maximum | **VDC** | <br>24<br>12<br>30 |
| **Input current** (maximum, per input) | **mA** | 20 |
| **Maximum input frequency** | **MHz** | 1 |
| **Minimum pulse width** | **ns** | 250 |

### 8.1.7 Digital outputs DOUT0, DOUT1 - status and general purpose (X3)

| | Unit | All models |
|---|---|---|
| **User supply** (maximum) | **V** | 28 |
| **Output current** (max. continuous) | **mA** | 100 |
| **Fuse**<br>Approximate trip current<br>Reset time | <br>**mA**<br>**s** | <br>200<br><20 |
| **Update interval** | **ms** | 1 |

### 8.1.8 Incremental encoder feedback option (X8)

| | Unit | All models |
|---|---|---|
| **Encoder input** | | RS422 A/B Differential, Z index |
| **Maximum input frequency** (quadrature) | **MHz** | 8 |
| **Hall inputs** | | RS422 A/B Differential |
| **Output power supply to encoder** | | 5V, 200mA max. |
| **Maximum recommended cable length** | | 30.5m (100ft) |

### 8.1.9 SSI encoder feedback option (X8)

| | Unit | All models |
|---|---|---|
| **SSI encoder inputs** | | Differential Data and Clock |
| **Operating mode** (Baldor motors) | | Single turn. Positioning resolution up to 262144 counts/rev (18-bit) |
| **Output power supply to encoder** | | 5V, 200mA max. |
| **Maximum recommended cable length** | | 30.5m (100ft) |

### 8.1.10 SinCos / EnDat encoder feedback option (X8)

| | Unit | All models |
|---|---|---|
| **Absolute encoder input** | | EnDat / SinCos differential inputs and data input |
| **Operating modes** (Baldor motors) | | Single or multi-turn. 512 or 2048 Sin/Cos cycles per turn, with absolute positioning resolution of 2048 or 8192 steps.<br><br>(Many other encoder specifications are supported - contact Baldor.) |
| **Output power supply to encoder** | | 5V, 200mA max. |
| **Maximum recommended cable length** | | 30.5m (100ft) |

### 8.1.11 Ethernet interface

| *Description* | Unit | Value |
|---|---|---|
| **Signal** | | 2 twisted pairs, magnetically isolated |
| **Protocols** | | ETHERNET Powerlink & TCP/IP |
| **Bit rates** | **Mbit/s** | 100 |

### 8.1.12 CAN interface

| *Description* | Unit | Value |
|---|---|---|
| **Signal** | | 2-wire, isolated |
| **Channels** | | 1 |
| **Protocol** | | CANopen |
| **Bit rates** | **Kbit/s** | 10, 20, 50, 100, 125, 250, 500, 1000 |

### 8.1.13 Environmental

| *All models* | Unit | All models | | |
|---|---|---|---|---|
| **Operating temperature range*** | | **°C** | | **°F** |
| Minimum<br>Maximum<br>Derate | | +0<br>+45<br>See sections 3.2.2 to 3.2.5 | | +32<br>+113<br>See sections 3.2.2 to 3.2.5 |
| **Storage temperature range*** | | -40 to +85 | | -40 to +185 |
| **Humidity** (maximum)* | **%** | 93 | | |
| | | **3A** | **6A** | **9A** |
| **Forced air cooling flow** (vertical, from bottom to top) | **m/s** | None required | 1 | 2.5 |
| **Maximum installation altitude** (above m.s.l.) | **m**<br><br>**ft** | 1000<br>Derate 1.1% / 100m over 1000m<br><br>3300<br>Derate 1.1% / 330ft over 3300ft | | |
| **Shock*** | | 10G | | |
| **Vibration*** | | 1G, 10-150Hz | | |
| **IP rating** | | IP20** | | |

* MicroFlex e100 complies with the following environmental test standards:

BS EN60068-2-1:1993 low temperature operational 0°C.
BS EN60068-2-2:1993 high temperature operational 45°C.
BS EN60068-2-1:1993 low temperature storage/transportation -40°C.
BS EN60068-2-2:1993 high temperature storage/transportation +85°C.
BS 2011:part2.1 Cb: 1990: 45°C 93%RH humidity/high temperature operational.
DIN IEC 68-2-6/29

** MicroFlex e100 complies with EN61800-5-1:2003 part 5.2.2.5.3 (Impact test), provided all front panel connectors are inserted.

### 8.1.14 Weights and dimensions

| *Description* | **3A** | **6A** | **9A** |
|---|---|---|---|
| **Weight** | 1.45kg (3.2 lb) | 1.5kg (3.3 lb) | 1.55kg (3.4 lb) |
| **Nominal overall dimensions** | 180mm x 80mm x 157mm (7.1in x 3.2in x 6.2in) | | |

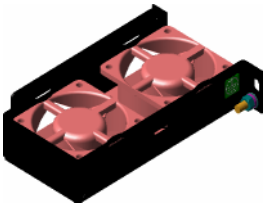
# A.1 Introduction

This section describes accessories and options that you may need to use with your MicroFlex e100. Shielded (screened) cables provide EMI / RFI shielding and are required for compliance with CE regulations. All connectors and other components must be compatible with the shielded cable.

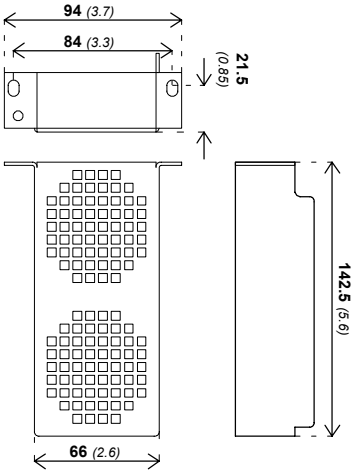
## A.1.1 Fan tray

The fan tray (Baldor part FAN001-024) provides sufficient cooling for the 3A, 6A or 9A MicroFlex e100. It requires 23 - 27.5VDC at 325mA, which may be sourced from the same filtered control circuit supply used for the MicroFlex e100. The MicroFlex e100 is UL listed (file NMMS.E128059) when used in conjunction with the fan tray, mounted exactly as shown in Figure 45.

**Fan tray**
FAN001-024

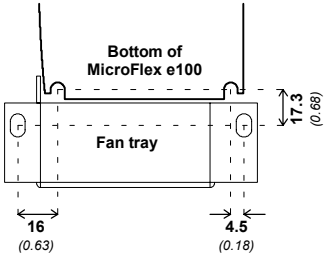


**Fan tray dimensions**




**Assembled MicroFlex e100 and fan tray**

**Position of fan tray mounting holes relative to MicroFlex e100**




It is important that the fan tray is mounted in close proximity to the MicroFlex e100 as shown above. Failure to do so will result in decreased cooling efficiency.

**Figure 45 - Fan tray**

## A.1.2 Footprint filter (single-phase only)

The single-phase footprint AC power filter (Baldor part FI0029A00) provides mounting holes for the MicroFlex e100 and fan tray. This allows the filter, fan tray and MicroFlex e100 to use minimal panel mounting space. See section A.1.3 for details of filter FI0029A00.

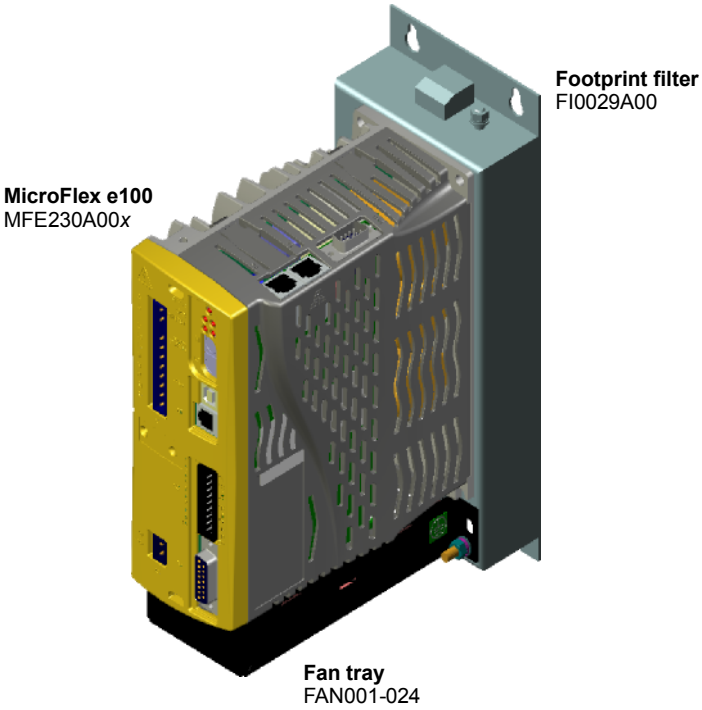


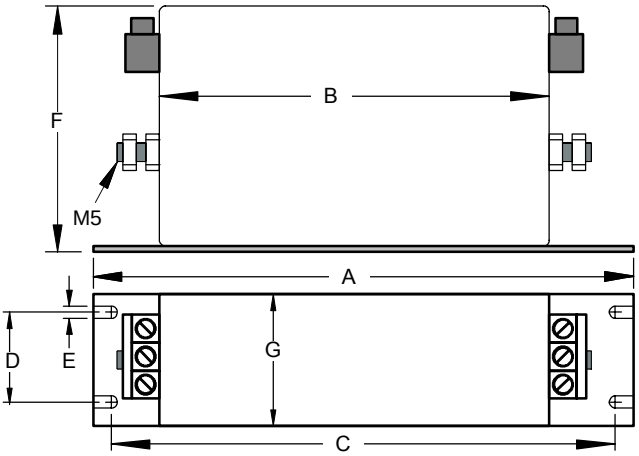

**Figure 46 - Assembled footprint filter, fan tray and MicroFlex e100**

## A.1.3 EMC filters

AC filters remove high frequency noise from the AC power supply, protecting the MicroFlex e100. These filters also prevent high frequency signals from being transmitted back onto the power lines and help meet EMC requirements. To select the correct filter, see sections 3.4.7 and 3.4.8.

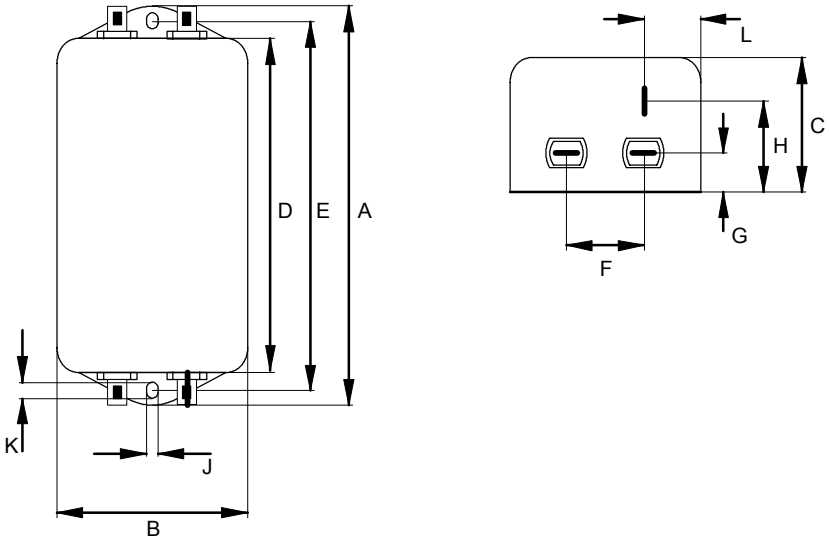
### A.1.3.1 Catalog numbers

| Baldor catalog number | Rated volts | Rated amps @ 40°C | Leakage current (mA) | Weight kg (lbs) |
|---|---|---|---|---|
| FI0014A00 | 250 | 3 | 0.4 | 0.27 (0.6) |
| FI0015A00 | 250 | 6 | 0.4 | 0.45 (0.99) |
| FI0015A01 | 250 | 10 | 0.4 | 0.73 (1.61) |
| FI0015A02 | 250 | 12 | 0.4 | 0.73 (1.61) |
| FI0018A00 | 480 | 7 | 33 | 0.5 (1.1) |
| FI0018A03 | 480 | 16 | 33 | 0.8 (1.76) |
| FI0029A00 | 250 | 22 | 33 | 3.0 (6.6) |



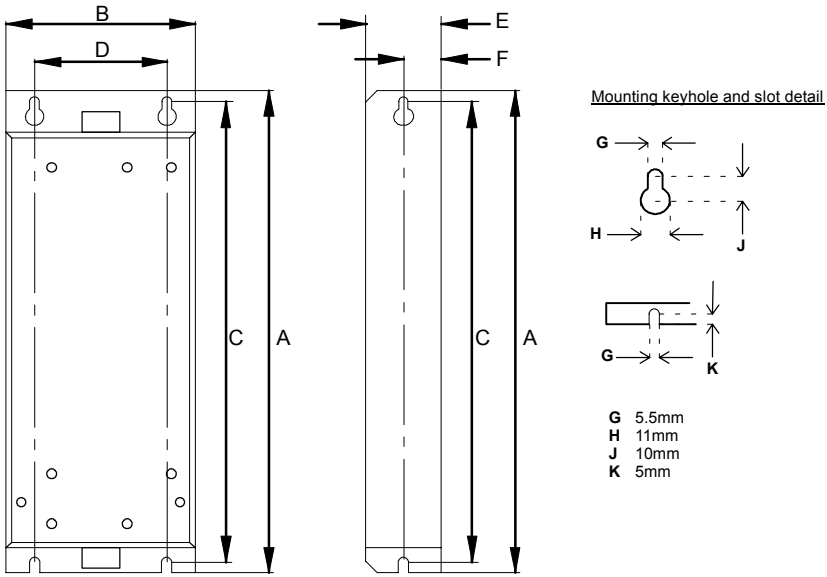

| | Dimensions *mm (inches)* | |
|---|---|---|
| **Dimension** | **FI0018A00** | **FI0018A03** |
| **A** | 190 (7.48) | 250 (9.84) |
| **B** | 160 (6.30) | 220 (8.66) |
| **C** | 180 (7.09) | 235 (9.25) |
| **D** | 20 (0.79) | 25 (0.98) |
| **E** | 4.5 (0.18) | 5.4 (0.21) |
| **F** | 71 (2.80) | 70 (2.76) |
| **G** | 40 (1.57) | 45 (1.77) |

**Figure 47 - Filter dimensions, types FI0018A00 and FI0018A03**




| | Dimensions *mm (inches)* | | |
|---|---|---|---|
| **Dimension** | **FI0014A00** | **FI0015A00** | **FI0015A01 FI0015A02** |
| **A** | 85 (3.35) | 113.5 (4.47) | 156 (6.14) |
| **B** | 54 (2.13) | 57.5 (2.26) | |
| **C** | 40 (1.57) | 46.6 (1.83) | |
| **D** | 65 (2.56) | 94 (3.70) | 130.5 (5.14) |
| **E** | 75 (2.95) | 103 (4.06) | 143 (5.63) |
| **F** | 27 (1.06) | 25 (0.98) | |
| **G** | 12 (0.47) | 12.4 (0.49) | |
| **H** | 29.5 (1.16) | 32.4 (1.28) | |
| **J** | 5.3 (0.21) | 4.4 (0.17) | 5.3 (0.21) |
| **K** | 6.3 (0.25) | 6 (0.24) | |
| **L** | 13.5 (0.53) | 15.5 (0.61) | |

**Figure 48 - Filter dimensions, types FI0014A00, FI0015A00, FI0015A01, FI0015A02**




Dimensions shown as: **mm** *(inches)*.

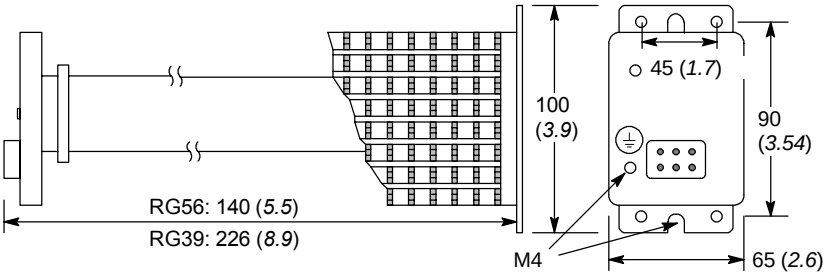
| | **Dimensions** *mm (inches)* |
|---|---|
| **Dimension** | **FI0029A00** |
| **A** | 255 (10.04) |
| **B** | 100 (3.94) |
| **C** | 244.5 (9.63) |
| **D** | 70 (2.76) |
| **E** | 40 (1.57) |
| **F** | 20 (0.79) |

**Figure 49 - Filter dimensions, type FI0029A00**

## A.1.4 Regeneration resistors

Depending on the application, MicroFlex e100 might require an external regeneration resistor to be connected to pins R1 and R2 of connector X1. The regeneration resistor dissipates energy during braking to prevent an over-voltage error occurring.

Baldor part number RG56 is recommended (56Ω, 44W). However, if the required dissipation is greater than this, Baldor part number RG39 may be used, rated at 100W.




Dimensions: mm *(inches)*

**Figure 50 - Regeneration resistor dimensions**

**WARNING**: A regeneration resistor may generate enough heat to ignite combustible materials. To avoid fire hazard, keep all combustible materials and flammable vapors away from the brake resistors. Ensure that the resistor has clearance of at least 50mm (2 in) above and below and 26mm (1 in) left and right.

## A.1.5 Motor power cables

| Cable rated current | Cable assembly description | Catalog number | Length | |
|---|---|---|---|---|
| | | | m | ft |
| 12 Amps | Power Cable: no connectors | CBL050-501 | Available by the meter or on 100m drum. | |
| | Power Cable Assembly: CE style threaded motor connector (motor end only) | CBL015SP-12*<br>CBL025SP-12<br>CBL030SP-12*<br>CBL050SP-12<br>CBL061SP-12*<br>CBL075SP-12<br>CBL091SP-12*<br>CBL100SP-12<br>CBL150SP-12<br>CBL152SP-12*<br>CBL200SP-12<br>CBL229SP-12* | 1.5<br>2.5<br>3.0<br>5.0<br>6.1<br>7.5<br>9.1<br>10<br>15<br>15.2<br>20<br>22.9 | 5<br>8.2<br>10<br>16.4<br>20<br>24.6<br>30<br>32.8<br>49.2<br>50<br>65.6<br>75 |
| 20 Amps | Power Cable: no connector | CBL051-501 | Available by the meter or on 100m drum. | |
| | Power Cable Assembly: CE style threaded motor connector (motor end only) | CBL015SP-20*<br>CBL025SP-20<br>CBL030SP-20*<br>CBL050SP-20<br>CBL061SP-20*<br>CBL075SP-20<br>CBL091SP-20*<br>CBL100SP-20<br>CBL150SP-20<br>CBL152SP-20*<br>CBL200SP-20<br>CBL229SP-20* | 1.5<br>2.5<br>3.0<br>5.0<br>6.1<br>7.5<br>9.1<br>10<br>15<br>15.2<br>20<br>22.9 | 5<br>8.2<br>10<br>16.4<br>20<br>24.6<br>30<br>32.8<br>49.2<br>50<br>65.6<br>75 |
| 35 Amps | Power Cable: no connector | CBL052-501 | Available by the meter or on 100m drum. | |

* Available in North and South America only.

## A.1.6 Motor power cable part numbers

For easier installation, it is recommended that a color-coded motor power cable is used. A description of a BSM rotary motor power cable catalog number is shown here, using the example number **CBL025SP-12**:

| | Meaning | Alternatives |
|---|---|---|
| **CBL** | The item is a cable | - |
| **025** | Indicates the length, in this example 2.5 meters | Various: see section A.1.5. |
| **SP** | The cable is a **S**ervo motor **P**ower cable | - |
| **12** | Current rating of 12A | **20**=20A |

Motor power cables include the motor power connector. Larger motors requiring 35A cable normally use terminal box connections, so a motor power connector is not required.

### A.1.7 SSI feedback cables

This table lists part numbers of feedback cables for use with the MicroFlex e100:

| Cable assembly description | Catalog number | Length | |
|---|---|---|---|
| | | m | ft |
| SSI Feedback Cable: no connectors | CBL044-501 | Available by the meter or on 100m drum. | |
| Feedback Cable Assembly: CE style threaded motor connector and low density 15-pin D-type drive connector | CBL015SF-S2* | 1.5 | 5 |
| | CBL025SF-S2 | 2.5 | 8.2 |
| | CBL030SF-S2* | 3.0 | 10 |
| | CBL050SF-S2 | 5.0 | 16.4 |
| | CBL061SF-S2* | 6.1 | 20 |
| | CBL075SF-S2 | 7.5 | 24.6 |
| | CBL091SF-S2* | 9.1 | 30 |
| | CBL100SF-S2 | 10 | 32.8 |
| | CBL150SF-S2 | 15 | 49.2 |
| | CBL152SF-S2* | 15.2 | 50 |
| | CBL200SF-S2 | 20 | 65.6 |
| | CBL229SF-S2* | 22.9 | 75 |

* Available in North and South America only.

### A.1.8 Encoder / Hall feedback cables

This table lists part numbers of encoder feedback cables for use with the MicroFlex e100:

| Cable assembly description | Catalog number | Length | |
|---|---|---|---|
| | | m | ft |
| Encoder Feedback Cable: no connectors | CBL043-501 | Available by the meter or on 100m drum. | |
| Feedback Cable Assembly: CE style threaded motor connector (motor end only) | CBL025SF-E | 2.5 | 8.2 |
| Feedback Cable Assembly: CE style threaded motor connector and low density 15-pin D-type drive connector | CBL015SF-E2* | 1.5 | 5 |
| | CBL025SF-E2 | 2.5 | 8.2 |
| | CBL030SF-E2* | 3.0 | 10 |
| | CBL050SF-E2 | 5.0 | 16.4 |
| | CBL061SF-E2* | 6.1 | 20 |
| | CBL075SF-E2 | 7.5 | 24.6 |
| | CBL091SF-E2* | 9.1 | 30 |
| | CBL100SF-E2 | 10 | 32.8 |
| | CBL150SF-E2 | 15 | 49.2 |
| | CBL152SF-E2* | 15.2 | 50 |
| | CBL200SF-E2 | 20 | 65.6 |
| | CBL229SF-E2* | 22.9 | 75 |

* Available in North and South America only.

## A.1.9 EnDat (absolute encoder) and SinCos feedback cables

| Cable assembly description | Baldor catalog number | Length | |
|---|---|---|---|
| | | m | ft |
| Absolute encoder feedback cable: no connectors | CBL045-501 | Available by the meter or on 100m drum. | |
| Absolute encoder feedback cable assembly: CE style threaded motor connector and low density 15-pin D-type drive connector | CBL015SF-D2* | 1.5 | 5 |
| | CBL025SF-D2 | 2.5 | 8.2 |
| | CBL030SF-D2* | 3.0 | 10 |
| | CBL050SF-D2 | 5.0 | 16.4 |
| | CBL061SF-D2* | 6.1 | 20 |
| | CBL075SF-D2 | 7.5 | 24.6 |
| | CBL091SF-D2* | 9.1 | 30 |
| | CBL100SF-D2 | 10 | 32.8 |
| | CBL150SF-D2 | 15 | 49.2 |
| | CBL152SF-D2* | 15.2 | 50 |
| | CBL200SF-D2 | 20 | 65.6 |
| | CBL229SF-D2* | 22.9 | 75 |

* Available in North and South America only.

## A.1.10 Feedback cable part numbers

A description of a feedback cable catalog number is shown here, using the example number **CBL025SF-E2**:

| | Meaning | Alternatives |
|---|---|---|
| **CBL** | The item is a cable | - |
| **025** | Indicates the length, in this example 2.5 meters | Various: see sections A.1.7 to A.1.9. |
| **SF** | The cable is a **S**ervo motor **F**eedback cable | - |
| **E** | Encoder feedback cable with motor connector | **S**=SSI feedback cable<br>**D**=EnDat/SinCos feedback cable |
| **2** | Drive connector included:<br>15-pin D-type connector for all feedback types | **-** |

**Note:** Feedback cables have the outer shield tied to the connector housing(s).

If you are not using a Baldor cable with your chosen feedback device, be sure to obtain a cable that is a shielded twisted pair 0.34mm$^2$ (22 AWG) wire minimum, with an overall shield. Ideally, the cable should not exceed 30.5m (100ft) in length. Maximum wire-to-wire or wire-to-shield capacitance is 50pF per 300mm (1ft) length, to a maximum of 5000pF for 30.5m (100ft).

## A.1.11 Ethernet cables

The cables listed in this table connect MicroFlex e100 to other EPL nodes such as NextMove e100, additional MicroFlex e100s, or other EPL compatible hardware. The cables are standard CAT5 'crossover' Ethernet cables:

| Cable assembly description | Baldor catalog number | Length | |
|---|---|---|---|
| | | m | ft |
| CAT5 Ethernet cable | CBL002CM-EXS | 0.2 | 0.65 |
| | CBL005CM-EXS | 0.5 | 1.6 |
| | CBL010CM-EXS | 1.0 | 3.3 |
| | CBL020CM-EXS | 2.0 | 6.6 |
| | CBL050CM-EXS | 5.0 | 16.4 |
| | CBL100CM-EXS | 10.0 | 32.8 |

## B.1 Introduction

The MicroFlex e100 can use two main control configurations:

- Servo (Position).
- Torque Servo (Current).

Each configuration supports different control modes, selected by using the Tools, Control Mode menu item or by using the CONTROLMODE keyword in the Command window (see the Mint help file). The control configurations are described in the following sections.

### B.1.1 Servo configuration

The servo configuration is the default configuration for the drive, allowing the motor control system to operate as a torque controller, a velocity controller or a position controller. This configuration comprises 3 nested control loops; a current control loop, a velocity control loop and a position control loop, as shown in Figure 51.

The universal encoder interface reads rotor position from the encoder and estimates velocity. The commutation block uses the position to calculate the electrical angle of the rotor. The current sensor system measures U and V phase currents. These are fed into a current conversion block that converts them into quantities representing torque producing and magnetizing currents (the 'vector' currents which are locked to the rotor).

In the current control loop, a current demand and the final measured current values form the inputs to a PI (Proportional, Integral) control system. This control system generates a set of voltage demands that are fed into a PWM (pulse-width modulation) block. The PWM block uses the space-vector modulation method to convert these voltage demands into a sequence of U, V and W phase switching signals, which are applied to the output bridge of the drive. The PWM block uses the measured DC bus voltage to compensate for variations in supply voltage.

The torque controller converts a torque demand into a current demand and compensates for various load non-linearities. A 2-stage notch or low-pass filter allows the effects of load compliance to be reduced. To avoid motor damage, a user-defined application current limit is also applied, as well as individual positive and negative torque limits.

In the velocity control loop, a velocity demand and measured velocity form the inputs to a PI control system. The output of the control system is a torque demand which, when the drive is operating as a velocity controller, forms the input to the current control loop.

Finally, in the position control loop, a position demand and measured position form the inputs to a PID (Proportional, Integral, Differential) control system incorporating velocity feedback, velocity feed-forward and acceleration feed-forward. The output of the position control system is a velocity demand which, when the drive is operating as a position controller, forms the input to the velocity control loop.

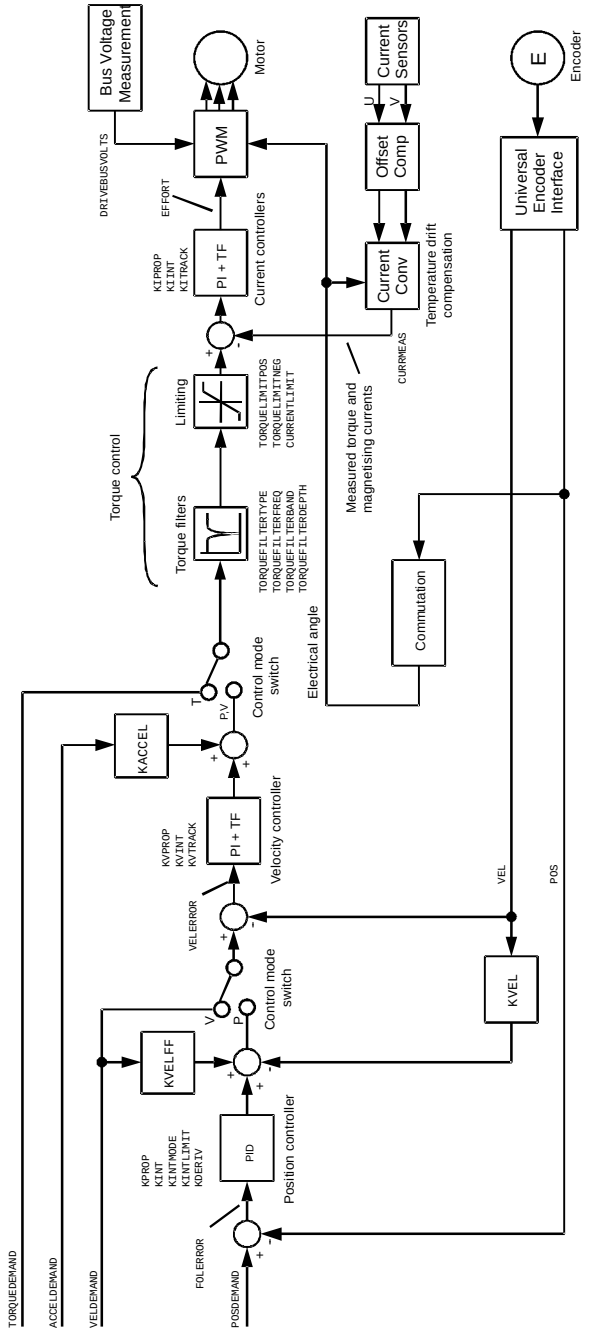



**Figure 51 - Servo configuration control structure**

## B.1.2 Torque servo configuration

Figure 52 shows the torque-servo control configuration. Here, the velocity loop has been removed and the output of the position controller is fed into the current loop via the torque filters.

The torque servo configuration is useful when the drive is operating as a closed-loop position controller and settling time must be minimized. Although the servo configuration tends to give better velocity tracking when operating in position mode, settling times can be longer.

The control mode switch allows the drive to operate in either torque or position modes, but not velocity mode.

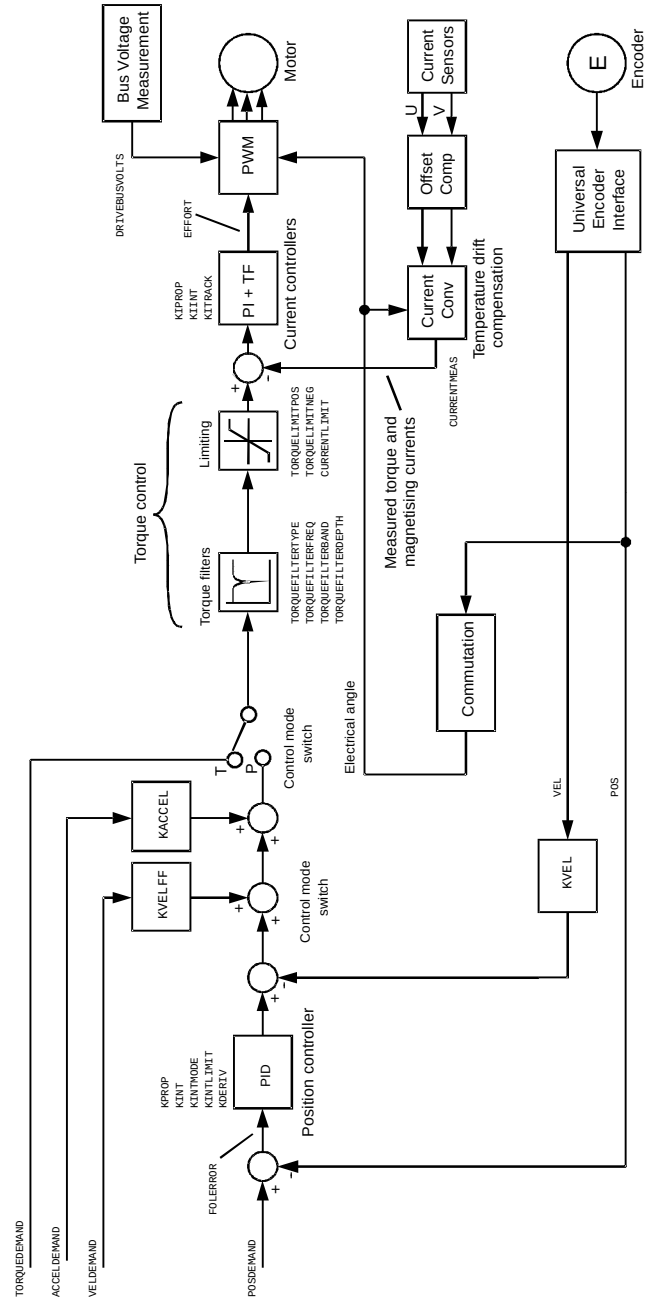



**Figure 52 - Torque Servo configuration control structure**

# C.1 Outline

This section provides general information regarding recommended methods of installation for CE compliance. It is not intended as an exhaustive guide to good practice and wiring techniques. It is assumed that the installer of the MicroFlex e100 is sufficiently qualified to perform the task, and is aware of local regulations and requirements. Baldor products that meet the EMC directive requirements are indicated with a “CE” mark. A duly signed CE declaration of conformity is available from Baldor.

## C.1.1 EMC Conformity and CE marking

The information contained herein is for your guidance only and does not guarantee that the installation will meet the requirements of the council directive 89/336/EEC.

The purpose of the EEC directives is to state a minimum technical requirement common to all the member states within the European Union. In turn, these minimum technical requirements are intended to enhance the levels of safety both directly and indirectly.

Council directive 89/336/EEC relating to Electro Magnetic Compliance (EMC) indicates that it is the responsibility of the system integrator to ensure that the entire system complies with all relative directives at the time of installing into service.

Motors and controls are used as components of a system, per the EMC directive. Hence all components, installation of the components, interconnection between components, and shielding and grounding of the system as a whole determines EMC compliance.

The CE mark informs the purchaser that the equipment has been tested and complies with the appropriate standards. It rests upon the manufacturer or his authorized representative to ensure the item in question complies fully with all the relative directives in force at the time of installing into service, in the same way as the system integrator previously mentioned. Remember that it is the instructions of installation and the product that should comply with the directive.

## C.1.2 MicroFlex e100 compliance

When installed as directed in this manual, MicroFlex e100 units meet the emission limits for an “industrial” environment, as defined by the EMC directives (EN61000-6-4: 2001). To meet the more stringent emission limits of the “residential, commercial and light industrial” environment (EN61000-6-3: 2001), the MicroFlex e100 must be mounted in a suitable metal cabinet incorporating 360° screened cable glands.

## C.1.3 Use of CE compliant components

The following points should be considered:

- **Using CE approved components will not guarantee a CE compliant system!**
- The components used in the drive, installation methods used, materials selected for interconnection of components are important.
- The installation methods, interconnection materials, shielding, filtering and earthing / grounding of the system as a whole will determine CE compliance.
- The responsibility of CE mark compliance rests entirely with the party who offers the end system for sale (such as an OEM or system integrator).

## C.1.4 EMC wiring technique

**Cabinet**
Using a typical electroplated zinc coated enclosure, connected to earth/ground, means that all parts mounted on the back plane are connected to earth/ground and all outer shield (screen) connections can be connected to earth/ground. Within the cabinet there should be a spatial separation between power wiring (motor and AC power cables) and control wiring.

**Shield (screen) connections**
All connections between components must use shielded cables. The cable shields must be connected to the enclosure. Use conductive clamps to ensure good earth/ground connection. With this technique, a good earth/ground shield can be achieved.

**EMC filters**
The filter should be mounted next to the MicroFlex e100. The connections between the MicroFlex e100 and the filter should use shielded (screened) cables. The cable shields should be connected to shield clamps at both ends.

**Earthing/grounding**
For safety reasons (VDE0160), all Baldor components must be connected to earth/ground with a separate wire. Earth/ground connections must be made from the central earth/ground (star point) to the regeneration resistor enclosure and from the central earth/ground (star point) to the power supply.

## C.1.5 EMC installation suggestions

To ensure electromagnetic compatibility (EMC), the following installation points should be considered to help reduce interference:

- Earthing/grounding of all system elements to a central earth/ground point (star point)
- Shielding of all cables and signal wires
- Filtering of power lines.

A proper enclosure should have the following characteristics:

- All metal conducting parts of the enclosure must be electrically connected to the back plane. These connections should be made with an earthing/grounding strap from each element to a central earthing/grounding point (star point). *
- Keep the power wiring (motor and power cable) and control wiring separated. If these wires must cross, be sure they cross at 90 degrees to minimize noise due to induction.
- The shield connections of the signal and power cables should be connected to the shield rails or clamps. The shield rails or clamps should be conductive clamps fastened to the cabinet. **
- The cable to the regeneration resistor must be shielded. The shield must be connected to earth/ground at both ends.
- The location of the AC filter has to be situated close to the drive so the AC power wires are as short as possible.
- Wires inside the enclosure should be placed as close as possible to conducting metal, cabinet walls and plates. It is advised to terminate unused wires to chassis ground.*
- To reduce earth/ground current, use the largest suitable wire available for earth/ground connections.

* Earthing/grounding in general describes all metal parts which can be connected to a protective conductor, e.g. housing of cabinet, motor housing, etc. to a central earth/ground point (star point). This central earth/ground point (star point) is then connected to the main plant (or building) earth/ground.

** Or run as twisted pair at minimum.

## C.1.6 Wiring of shielded (screened) cables

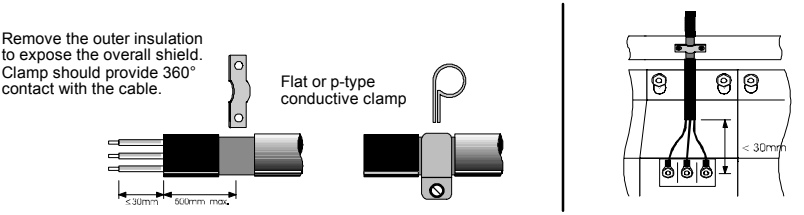



**Figure 53 - Earthing/grounding cable shields**

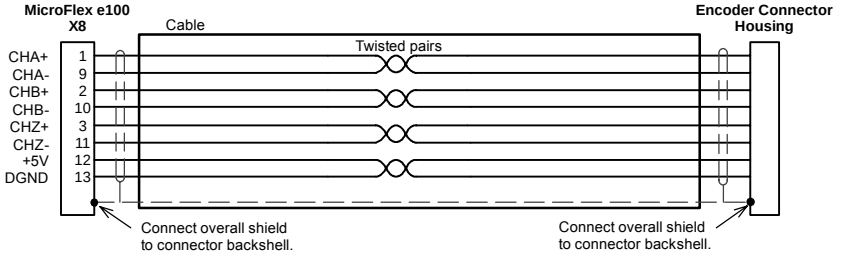



**Figure 54 - Encoder signal cable grounding**

## F



## G



## H



## I



## L



## M

## N



## O



## P



## R



## S



## T

## U



## W

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